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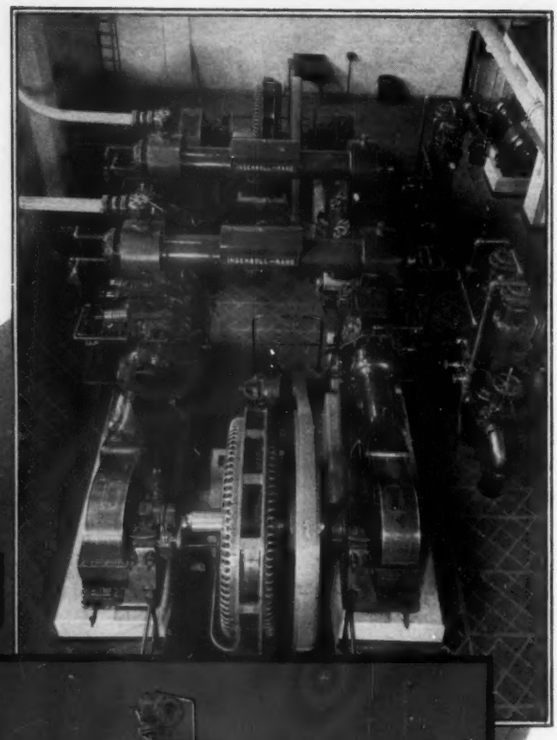
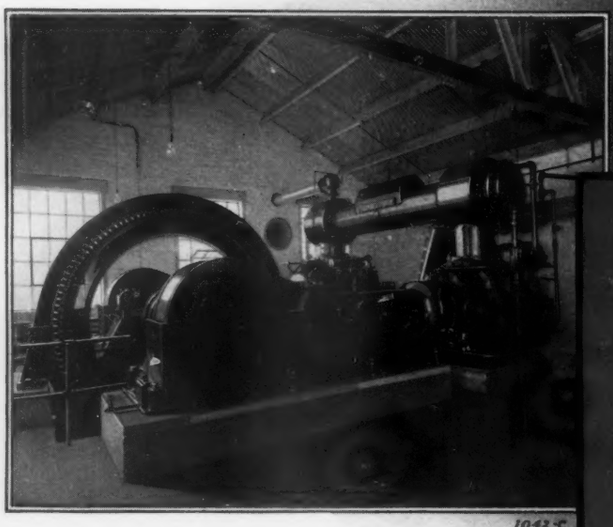
Ewing Galloway, New York

This picturesque covered bridge that harks back to a former era in roadbuilding crosses a stream in the mountains of Virginia.

A Safe Investment Paying Big Dividends



Right--Two synchronous motor-driven compressors installed in a railroad shop.



1042-C

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Let us consult with you about your compressor equipment. Our engineers may be able to suggest methods for reducing your compressed air costs.

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As It Seems To Us

THE TOLL OF ACCIDENTS

NEARLY 100,000 persons die from accidents each year in the United States, and 10,000,000 are injured, according to the National Safety Council. The automobile continues to be the most telling instrument of death. It accounts for about one-third of the fatalities. It will come as a surprising fact to most of us that the home is one of the most prolific producers of mishaps. Four out of every ten persons hurt each year suffer their injuries in bathrooms, kitchens, attics, garages, and elsewhere around places of residence.

Contrary to the general trend, industry is reducing the number of accidents for which it is responsible. Only about 3 per cent of the fatalities occur in manufacturing plants proper. Constant vigilance and patient education of workmen are bringing about this improvement. Industry conducts an organized battle against carelessness that is slowly but surely having its effect. Where workers can be subjected to discipline, the frequency of accidents can be lessened. It is upon the highways and streets, where little control can be exerted, that negligence and thoughtlessness take their greatest toll.

Eye accidents, the National Society for Prevention of Blindness informs us, make up 10 per cent of the cases in which workers are incapacitated for one day or longer. The total time lost from eye injuries is estimated to be 3,600,000 days a year. The direct and indirect monetary cost is placed at $50,000,000.

That such accidents can be cut down by systematically combating them is proved by the experience of the Pullman Company, which has a record of six years without an eye injury among the thousands of men engaged in its shops in Chicago and elsewhere. This has been accomplished by vigorously enforcing a rule that everyone must wear goggles while on duty. Even visitors must conform to this regulation. Employees who ignore the mandate are dismissed. This might seem a bit harsh, were it not for the results that have been achieved. Workmen grumbled at first, but since they have learned how the order affects their welfare, they are glad enough to obey it.

CAUSES OF FAILURES

THE current low ebb of trade is the occasion rather than the cause of many, and perhaps most, business failures, according to investigators of specific cases in New Jersey. Slipshod methods and practices are held to be at the bottom of the majority of bankruptcies.

The study which produced these conclusions was made by the United States Department of Commerce in conjunction with several interested agencies. It covered 612 cases of bankruptcy and other failures during 1929 and 1930. Included were 487 business establishments and 125 wage earners and professional persons. Among the business group were 301 retailers, 102 contractors, 33 real-estate dealers, 28 manufacturers, 15 wholesalers, and 8 farmers.

Less than half the concerns and individuals kept adequate records, and two-fifths of them never took an inventory. Excessive losses from bad debts showed poor credit systems. Normal credit losses of retailers who failed were eight times as great as those of going concerns, and installment credit losses were five times as great. Speculation, personal extravagance, dishonesty, illness, and excessive overhead expenses entered into some of the cases.

A GOLD MEDAL FOR A GOLD MINER

YEARS ago, the Treadwell Mine in Alaska was one of the world's fabled producers of gold. High-grade mineral came from it in a steady stream to swell the coffers of its fortunate owners. The Treadwell was rich, but its ore shoots extended beneath the ocean, and those directing it knew that they were running a race with time. They were aware that some day they would lose that race, and that untold tons of water would come tumbling into the stopes and drifts and put an end to the harvest of gold.

FREDERICK W. BRADLEY, president of the company that was operating the Treadwell, began to cast about for another property to take its place. Across the channel, at Juneau, was a mountain of low-grade ore. He organized the Alaska Juneau Gold Mining Company; and when the sea drowned the Treadwell he shifted his efforts to the new enterprise. Early he learned that Juneau was going to be a hard nut to crack. It had little rich ore, and could never be made to pay unless low-cost methods were evolved to glean its gold.

This meant just one thing: the handling of large tonnages. A system of mining was devised which permitted breaking vast blocks of ore in giant stopes at surprisingly little expense. Speedy, economical transportation was provided. At Juneau, two miles away, a mill was erected to concentrate the lean ore. Everything had been figured out on paper to produce a profit; but actual results were disappointing. Handling ore containing only about $1 in gold to the ton ate up more than the thin margin of charges that was permissible.

Thereupon Mr. BRADLEY and his associates set to work. Slowly but surely they whittled down costs per ton, pruning a cent here and a cent there. Multiplied by thousands of tons a day, these pennies grew into dollars with amazing rapidity. At the end of 1924 came the announcement that a profit of eight cents a ton had been made. Seven years later the company was out of the red and a dividend was paid. In recognition of all this, the American Institute of Mining and Metallurgical Engineers a few weeks ago awarded to Mr. BRADLEY the WILLIAM LAWRENCE SAUNDERS Gold Medal for Distinguished Achievement in Mining. This award was established in 1927 by the late Mr. SAUNDERS, the founder and first editor of *Compressed Air Magazine*.

Aside from his services to Alaska Juneau, Mr. BRADLEY has many other mining interests. Among them is the Bunker Hill & Sullivan Mining & Concentrating Company, of which he is president. He was born of an engineer father in a mining district of California. After spending three years in the mining department of the University of California, he left to enter active mining work in 1884. He was awarded a degree in 1930. Mr. BRADLEY lives in San Francisco.

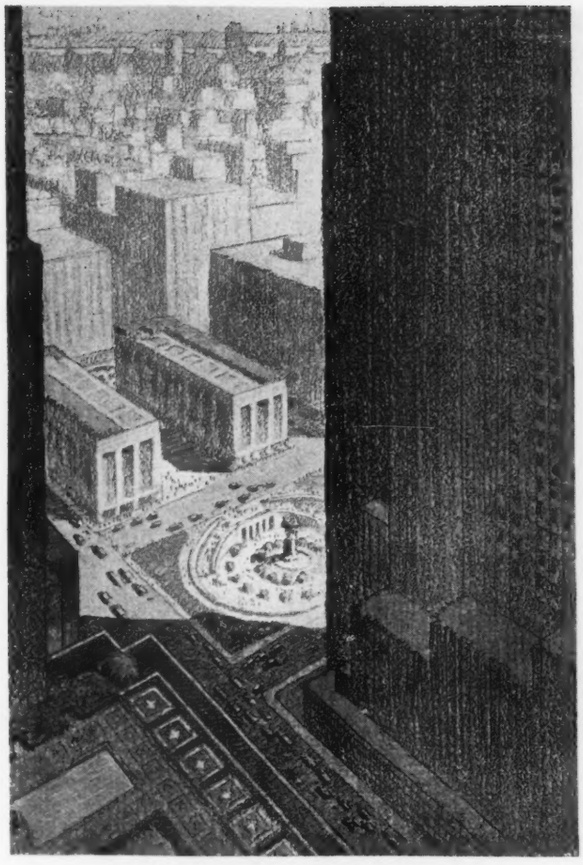
BOOM IN PROSPECTING

EVEN a depression can produce a boom, as is set forth in our article in this issue, *The Prospector Comes Back*. Every gold-producing section in the world had its quota of prospectors last year, and 1932 probably will see even more men in the hills.

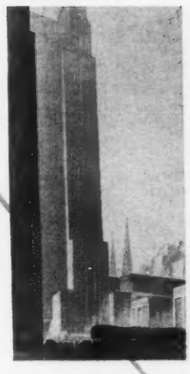
Although lode mining offers the better chance of large ultimate returns, panning and sluicing of gravels yields quicker and surer results and is, accordingly, the choice of those with limited funds. The search for gold in place is ordinarily a feast-or-famine affair. Either you hit it or you don't. No man without a sizable grubstake can afford to gamble on this form of prospecting. It is for this reason, in a time when the immediate concern is an income sufficient to keep body and soul together, that most gold seekers are turning to the beds of streams.

While machinery and modern methods are more economical for quantity production, it would seem that man must sometimes capitalize his own labor to obtain a living wage from small-scale dredging. At any rate, several instances in Colorado last summer indicated this to be true. Several parties were making good wages with crude implements, only to find that their overhead ate up the profits when they installed a power shovel and a gravity concentrator. Human eyes and arms are capable of greater selectivity of material than is a shovel dipper, as was demonstrated when a return to primitive methods restored profits.

Architectural perspective of Rockefeller Center viewed from aloft.



Looking down on the Forum from the roof of the International Music Hall.



Birth of a City Within a City

Rockefeller Center, Because of Taxes and Other Heavy Charges, Is Being Rushed to Completion to Insure Income at an Early Date

R. G. SKERRETT

ONE may well be surprised, in these days of enforced economies, that any single private enterprise should have the courage to engage confidently in a $250,000,000-building development that will reach magnificent proportions in the course of three or four years. Such, however, is the determination of the Metropolitan Square Corporation, which is now engaged in creating Rockefeller Center in the very heart of New York City.

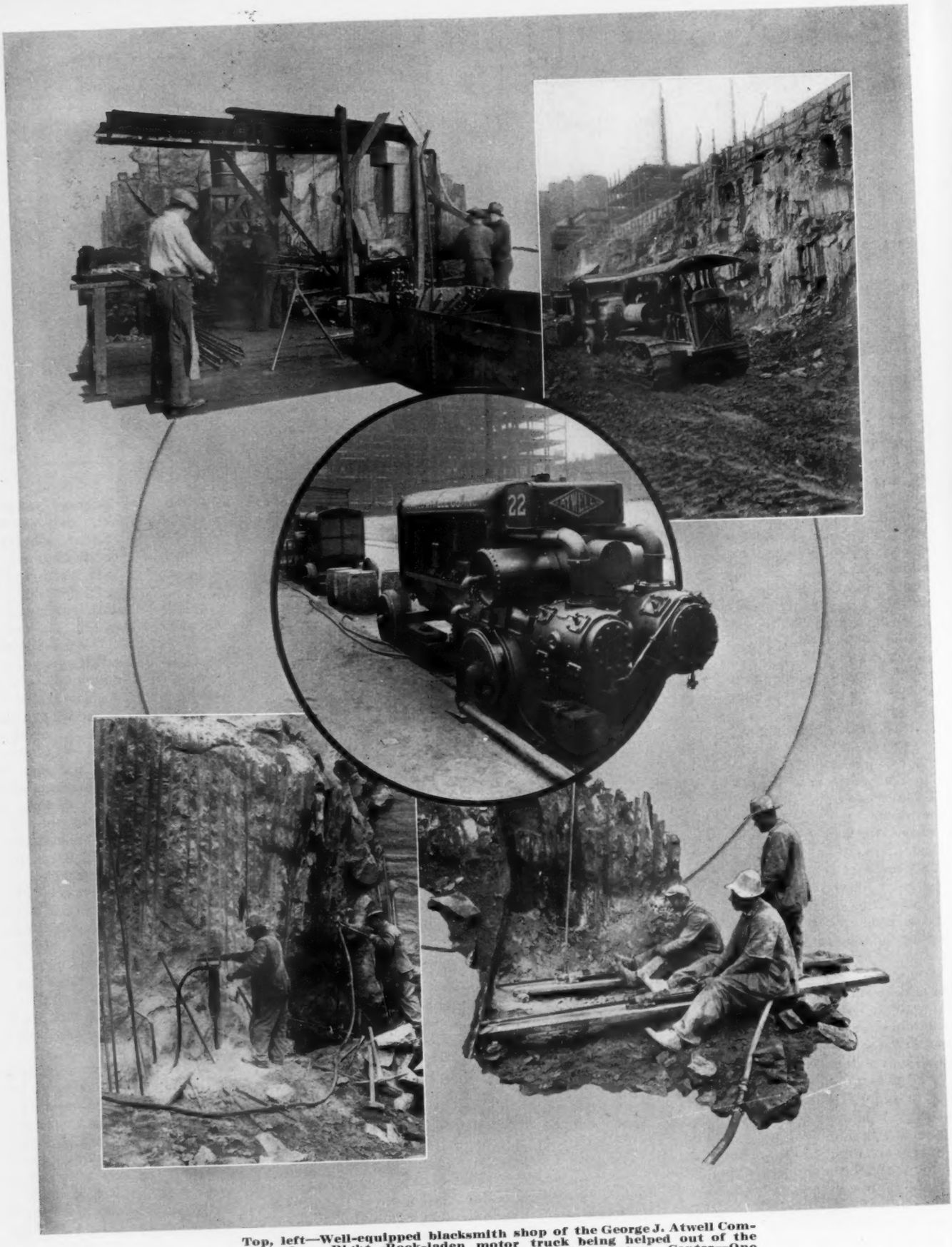
The expenditure of so much money within a comparatively brief period will be a veritable boon to the multiplicity of businesses and lines of endeavor that will contribute to the consummation of this stupendous project—a project that, in its completed form, will be a central source of entertainment, culture, and business in its varied branches. But before touching upon any of the engineering and architectural aspects of the undertaking, let us see how the actual rearing of this unique city within a city will play a notably helpful part in stimulating productive activity in numerous directions.

Experts engaged upon the development have estimated that no fewer than 10,000,000 man-days of eight hours each will be required in making, transporting, and erecting all the materials and equipment that will go into the ten great building units that will occupy sites within the reservation. It is computed that before the enterprise is finished, the number of workers that will be employed directly and indirectly will exceed 56,000. Expressed otherwise, it would take one man 33,330 years to do the whole task, provided he were competent to deal efficiently with the manifold demands.

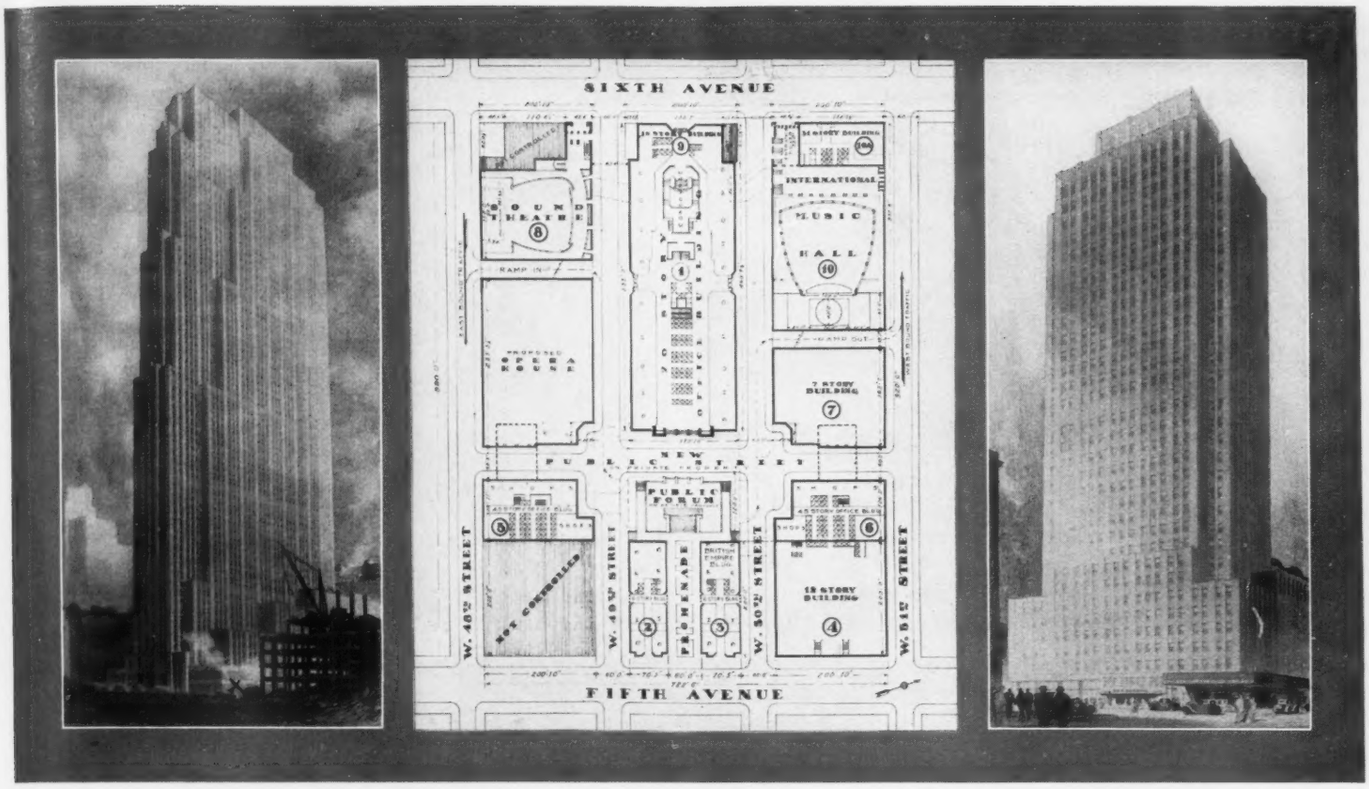
The job might well seem to be one calling for the individual strength and capacity of such fabulous creatures as titans and genii; but the burden of accomplishment will rest upon the shoulders of modern men and their effective use of present-day machinery of many kinds and of varied potentialities. Apart from these, ultimate success in the erection of the mammoth buildings will hinge upon the employment of novel production methods and the wide utilization of nicely standardized patterns or templates that will make it possible to form structural parts and architectural fittings in far-flung and disassociated plants, and to do this so precisely that these units can be brought together perfectly by the comparatively simple agencies of air-driven riveting hammers, wrenches, screw drivers, and welding torches. The procedure will differ but little from the practices followed during the World War in building and outfitting fabricated ships.

Many have asked, and hundreds of thousands are still wondering how Rockefeller Center—widely known as Radio City—was conceived; and it is appropriate that these questioning minds should be answered now. In the fall of 1928, John D. Rockefeller, Jr., acquired long-term possession of substantially three blocks bounded by Fifth and Sixth Avenues and 48th and 51st Streets—an expanse of twelve acres lying in the very midst of the busiest business section of midtown Manhattan. Mr. Rockefeller was thus placed in the unique position of being able to develop as a whole an area that would lend itself to amazing architectural possibilities—and the financier wisely decided to draw upon the resourcefulness of a number of the ablest builders and architects in the Metropolis in creating a district that would be not only useful but distinctive and beautiful.

Because the project has heretofore been generally known as Radio City, and much has been said about its entertainment aspect, the point should be made that the amusement features of the enterprise will absorb less than 30 per cent of the developed area. Spectacular as the scheme is, it is a serious financial undertaking that will lend itself to many services and departments of business. The outstanding aim is to give a new significance to city planning; to create a harmonious group of structures that will stand forth for a goodly period of years as a well-balanced and imposing aggregation; and to



Top, left—Well-equipped blacksmith shop of the George J. Atwell Company, Inc. Right—Rock-laden motor truck being helped out of the excavation for the central building by caterpillar tractor. Center—One of the big XL portable compressors which have supplied air on the site of the central office building. Bottom, left—Some of the powerful "Jackhamers" that have enabled the Atwell Company to do its excavating on schedule. Right—Driving a line of snake holes with S-68 "Jackhamers".



Ground plan of Rockefeller Center and the surrounding thoroughfares, with the 70-story office building at the left and the Sixth Avenue facade of the 31-story office building at the right.

provide an example that will serve as an inspiration and a guide in municipal betterment. The imagination of the populace has been caught by the fanciful phases of the project, and has come to judge the work in hand mainly as the materialization of a Maxfield Parrish dream city. We wish to dispel this misconception and, at the same time, to emphasize the worth-while practicality of the development—wonderfully impressive as it will be because of the magnificence of its proportions and the architectural charm of its modeling and decorative finish.

As Merle Crowell has so well expressed it: "Fifty years ago Radio City could not have been built successfully. New York was not ready for it. We were busy getting big; we were having our growing pains; we had not yet escaped from the awkward age. The aesthetic progeny of big business was still in the Never-Never Land, waiting to be born, while captains of industry were hewing and hamme ing out the foundations of material well-being. But a new era is here or hereabouts. The people of New York, still demanding the best in the old order, are now ready and able to enjoy beauty, new ideals in architecture, restful spaces, and fresh wonders from the capacious pockets of old Mother Nature".

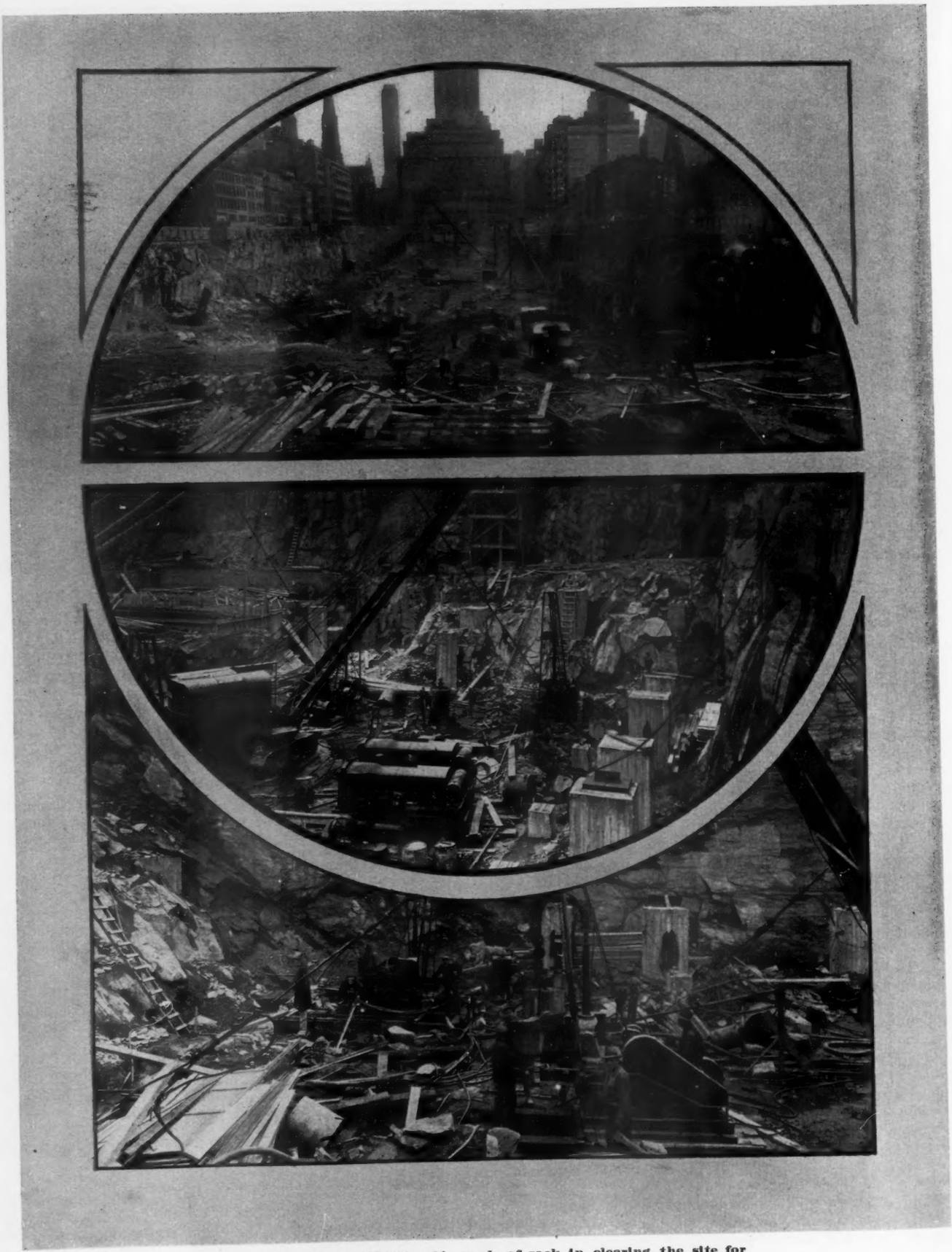
Manifestly, no single structure of man's making can satisfy these diversified requirements; but it is possible to achieve this through the medium of an imposing group of buildings that are so inter-related in their get-up and so placed geometrically on a prescribed reservation that the assemblage expresses the consummation of a vast, balanced, and unified design. In Rockefeller Center, a daily resident and transient population of quite 150,000 persons will be able to find an atmosphere of uplift in their working hours; varied forms of entertainment close by for their leisure; and that repose and refreshment of spirit generally born of the contemplation of beauty.

Among the structures that will rise on the three blocks in process of transformation will be the world's largest office building and the largest theater yet planned; and besides these there will be eight other units of monumental dimensions. For the sake of easy understanding, a ground plan of the development is reproduced to show the general disposition of the several main structures. The principal feature is the dominating 70-story office building, which will occupy more than half the block between Fifth and Sixth Avenues and be flanked by 49th and 50th Streets. It is to have a gross floor space of approximately 2,900,000 square feet—an area that will considerably exceed that of any other building of its kind in existence. This gigantic edifice will rise 850 feet above the street; will have two basement levels; and will have a 16-story wing that will front on Sixth Avenue. East and west, the ground plan will have a length of 535 feet; and from north to south it will measure 190 feet 10 inches. The structural framework will be made up of 50,000 tons of steel. Its external walls will admit light and air through 6,000 windows.

Architectural conception of a part of the Forum or sunken plaza.

The 70-story office building will be set centrally in the 3-block reservation, while the other towering but lesser structures will be situated at the corners of an imaginary quadrangle surrounding it. Two 45-story buildings will rise near the Fifth Avenue side and a 31-story structure will occupy the northwest corner as parts of the present plan. The steelwork for the latter is now up. These skyscrapers will constitute the conspicuous altitude feature of the development; and one can readily visualize the extraordinary impressiveness of this symmetrical arrangement—especially in view of the fact that a color scheme is to be carried out in the case of all structures in Rockefeller Center so as to produce harmony throughout.

In addition to the foregoing, there will be an artistically balanced building of about twelve stories in the northern block facing Fifth Avenue; and in the central block and



Top—Excavating 140,000 cubic yards of rock in clearing the site for the monumental 70-story office building. Center—Part of the excavation made by C. L. Smith, Inc., at the stage end of the International Music Hall. Bottom—Withdrawing a core section from a 36-inch-diameter shaft being sunk with a "Calyx" drill by C. L. Smith, Inc.

also fronting on Fifth Avenue there will be two 6-story business houses. One of these, at the southwest corner of Fifth Avenue and 50th Street, will be known as the British Empire Building, and will be the official headquarters in New York City for leading English financial, industrial, and commercial concerns. In short, it will add an international touch to Rockefeller Center. A large area in the southern block of the development, as yet unassigned, may become the site of a new home for the Metropolitan Opera Company. In this same block there is to be a sound-motion picture theater that will have a seating capacity for 3,500 people.

Reflecting pool in its setting of formal roof gardens.

The entire reservation is to be bisected north and south by a new street parallel with Fifth Avenue and 309 feet to the west of that well-known thoroughfare. This will facilitate entrance to and exit from the central area of Rockefeller Center. The new street, at mid-length, will flank a sunken plaza that is to be known as the Forum. It will occupy a ground area of substantially one acre, and represents a land value of $17,000,000! By way of adornment, this plaza will have a beautiful fountain against one of the side walls, and the pavement will be laid out in pleasing mosaic patterns. This is only one of many embellishments designed to arrest the eye and to charm; and among these artistic touches none will probably be more spectacular than the way in which flat roof areas will be disguised by landscape gardening that will turn these ordinarily homely expanses into enjoyable retreats and comforting vistas for the office workers.

Forty feet above the roof of the wing of the 70-story office building, a curved waterfall will send a tumbling torrent through a series of cascades that will end at the roof level in a reflecting pool about 30 feet wide and something like 100 feet long. There will be fountains at each end of this pool. Trees 30 feet in height, planted in 3 feet of soil and ingeniously anchored to brass rods set in the earth, together with shrubbery, flowers, grass, and well-arranged walks, will form a setting for this miniature Niagara and the expansive reflecting basin. Above the studios of the National Broadcasting Company—that is, in the lower roof area between the great main building and the east wall of the 16-story wing, will be two levels of landscaping. These will have terraces, flower beds, geometric grass plots, several small fountains, and benches—in brief, the appearance will be that of formal gardens. Kindred schemes of landscaping will be carried out on the roofs of the International Music Hall and the motion-picture theater.

The style of architecture of the towering buildings is of the set-back or stepped order now prescribed by municipal regulations to afford a maximum of light and air for any given ground area. This tends to massiveness of form and rigidness of line; but in the hands of skillful architects it is, nevertheless, possible to combine color, decorative finish, and refinement of detail so as to obtain richness of effect and even a measure of airiness as an offset to mere mass. Indeed, these results are promised by the architectural creators of Rockefeller Center, namely: Reinhard & Hofmeister; Corbett, Harrison & MacMurray; and Hood & Fouilhoux.

Inasmuch as the buildings are to be anchored deep in the rocky backbone of Manhattan Island, there will be available below the street level much space for many useful and profitable purposes such as shops, restaurants, and other conveniences for the many thousands of people who will work daily in Rockefeller Center. Much of this underground space will be utilized for motor-vehicle parking—possibly for bus terminals, as there will be ample room for 1,000 automobiles.

To sponsor and to finance the whole vast undertaking, John D. Rockefeller, Jr., formed the Metropolitan Square Corporation, of which Col. Arthur Woods is president. The firms of Todd, Robertson, Todd Engineering Corporation, and Todd & Brown, Inc., were selected as builders and managers and made responsible for the supervision of the whole task. In addition to the distinguished architects already mentioned, Clyde R. Place was appointed engineer in charge of the mechanical and electrical features of the development.

Many interesting and even astonishing figures have already been published concerning different phases of Rockefeller Center, but these would tend to confuse the reader if mentioned here. Our aim at present is to touch upon certain vitally necessary work now in hand that has to do with the preparation of the sites for some of the buildings—work requiring the excavating of many thousands of cubic yards of rock in a densely developed section of New York City. We shall deal with only two of these sites, because they represent distinctive aspects of this preliminary work and indicate in a general way what has been done or may still have to be done in other parts of the reservation.

The capacious motion-picture theater.

In the central block between 49th and 50th Streets, the excavating of the area from Sixth Avenue eastward to within a short distance of Fifth Avenue was awarded George J. Atwell Company, who started digging with shovels on July 23 of last year. At that time the area had been cleared of the buildings which had previously stood there—a considerable measure of the debris filling the erstwhile cellars of the old structures. Incidentally, it may be of interest to mention that before the wreckers began their operations there were 229 buildings on the three blocks that will be occupied by Rockefeller Center. The task of the power shovels was to remove the debris in the exposed cellars and to demolish the brick and stone masonry of foundation walls and partitions. As this progressed, it was revealed that most of the cellars had been excavated out of the solid ledge composed variously of mica schist and a variety of granite.

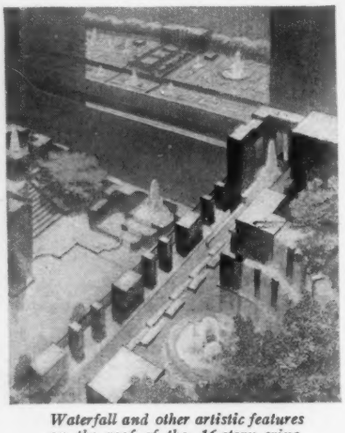
The cellars were generally about 8 feet deep, and, when cleared, became points of attack in dealing with the surrounding rock. The first operation consisted of driving, at short intervals, lines of snake holes that slanted downward and penetrated the rock from 16 to 18 feet. Down holes were drilled to an average depth of 14 feet; and in this manner the main mass of rock within the entire area was taken out in a series of benches. The contractor was not permitted to do any blasting within 20 feet of the sidewalk until he had line drilled that boundary to prevent the further transmission of the shock of explosion through the street paving to buildings standing on the opposite side of the contiguous thoroughfare. Similar line-drilling was done adjacent to the foundation walls of structures left standing on the reservation; and light charges of explosive were used only when the rock did not break of itself after drilling. The line-drilling has been done with Type S-68 "Jackhamers" which are mounted on quarry bars. Drills of the same sort, mounted in the same way, have been employed to line drill pits and trenches extending below basement levels. Rock surfaces, where irregular, have been chipped with CA-35 paving breakers.

The blacksmith shop on the Atwell contract is provided with two No. 50 sharpeners, three No. 26 oil furnaces, and one No. 4K shank grinder. The shop has had to condition from 900 to 1,200 pieces of drill steel daily so as to keep busy all the drills on the job. The granite formation which prevails is very hard to drill and seems to absorb the shock of explosion when blasted, so that it breaks into large pieces instead of shattering in to numerous small ones. The maximum depth to the general floor level is about 35 feet, but this is extended deeper for pier holes, elevator pits, etc. In fact, the power-plant excavation will reach 72 feet below the street level. All told, George J. Atwell Company has been called upon to excavate 160,000 cubic yards of material, of which 140,000 cubic yards is rock. The contractor has maintained his schedule ever since his first day on the job.

Air to operate the rock drills and the

blacksmith-shop equipment has been supplied by six portable compressors and five stationary machines. Two of the portables are of the XL type: the others are 10x8-inch Type 20 machines. The stationary compressors consist of two Class ER and three Type XCB units.

The excavating for the 31-story business building and for the great International Music Hall, both in the northwest section of the development, was awarded C. L. Smith, Inc. That job has entailed the removal of 80,000 cubic yards of rock down to the general level of the basement, 40 feet below the street. The work has been done with the aid of S-68 "Jackhamers"—the procedure being virtually like that employed in the neighboring excavation made by George J. Atwell Company. The rock formation is also similar. Compressed air has been furnished by twelve 10x8-inch Type 20 gasoline-driven portables. Rock surfaces have been trimmed where needed with CA-35 paving breakers. The blacksmith shop contains the following Ingersoll-Rand equipment: one No. 50 sharpener, one No. 26 oil furnace, and a No. 8 pedestal grinder.



Waterfall and other artistic features on the roof of the 16-story wing.

Probably the most unusual operation in connection with the preparation of the site of the International Music Hall, which will have a seating capacity for 6,500 persons, has been the sinking of sixteen deep shafts in which will be housed the elevator plungers that will raise and lower the stage and the orchestra independently of each other. The excavating of such shafts is ordinarily a tedious procedure, and the means adopted have saved much time. This is important to the Metropolitan Square Corporation, because that concern will continue to pay a heavy rental to Columbia University and a large sum in taxes on the property until revenue offsets these outlays. Calyx drills have been used to sink the shafts, which are 36 inches in diameter. Twelve of the shafts are 42 feet deep and the four others 28 feet 10 inches deep.

The twelve deep holes will contain the plungers that will raise and lower the central part of the stage, while the shallower shafts will house four plungers—two in front and two at the rear of the stage—that will elevate and lower the orchestra platform large enough to seat 75 musicians. This platform will be on wheels traveling on rails extending below and from front to rear of the stage; and, when in the back-stage position, it can, if desired, be lifted to a height of 13 feet above the normal stage level. The movement of the platform will be effected by electric mechanisms that can be controlled by the orchestra conductor while the musicians are at their appointed positions.

The central section of the stage, covering an area 70 feet long and 44 feet wide, will be in three divisions, each of which will be moved vertically by hydraulic elevators and independently of the two others. Each of these big elevator groups will weigh 80,000 pounds and be able to lift a maximum load of 30,000 pounds. Beneath this stage center there will be a basement having two levels, and settings for the stage will be made ready on either or both of these levels to facilitate the rapid shifting of scenery, etc. The maximum speed of vertical movement will be about 40 feet a minute, but the rate of travel can be varied and will be subject to very nice control. A central circular section of the stage, 40 feet in diameter, will be mounted on a turntable so that it can be revolved; and this novel arrangement will permit of a variety of unusual and spectacular effects. The plans for this department of the International Music Hall have been developed by Peter Clark, an engineer specializing in stage equipment.

The Calyx drills, of which there are three on the job, are like others of their type that have been used for sinking mine manholes and ventilator shafts and for drilling deep shafts for rock examination and for the mounting of tension posts forming part of the essential equipment of wire saws employed in quarrying slate, sandstone, granite, etc. Calyx drills are core drills, and, after penetrating to a depth of 4 to 5 feet, the cutting drum or bit is withdrawn and the core section broken free by driving a couple of wedges at one side of the abraded channel and then exploding in the annular slot a small charge of dynamite. This serves either to break free the core, so that it can be hoisted out as a single piece, or to shatter it so that it can be easily mucked by hand—workmen being lowered into the shaft for that purpose.

While each drill averages 4 feet of shaft-sinking per 8-hour shift, still a penetration of 18 inches an hour has been accomplished. The progress per shift is necessarily slowed up by the time that must be taken to detach a core and to extract it before lowering the drill and starting work afresh. Operations are carried on continuously for two shifts daily; and under favorable conditions one drill has excavated as much as 13 feet in sixteen hours. The abrasive action of the rotating drill is induced by "Calyxite"—hard shotlike bodies that are fed down to the cutting edge of the cylinder or bit. The drills are operated by electricity.

It is worth while noting that the Calyx drills on this job have performed excellently in spite of the fact that the formation penetrated is nearly vertical and, therefore, disposed to split off at times in wedge-shaped pieces that would ordinarily jam a tool attacking it. Experience in this case has served further to emphasize the adaptability of this tool that has been developed by Ingersoll-Rand Company.

Envisioning what Rockefeller Center will be when completed, one is warranted in recalling what Heinrich Heine said of the famous Cathedral of Amiens: "Built with the strength of Titans and decorated with the patience of dwarfs."

RAIL CARS WITH PNEUMATIC TIRES ASSURE RIDING COMFORT

YEARS of experimenting by the Michelin Tire Company of France have culminated in the introduction in that country of self-contained railroad cars equipped with pneumatic tires. Both the cars and the tires are of special design and, according to all reports, are giving satisfaction to the traveling public and to the operators. Nine different coaches were constructed before the model was produced that is now in use on some of the French branch lines. This vehicle accommodates 24 persons, and attains a normal speed on level stretches of 55 miles an hour and a top speed of 62 miles an hour. It assures a maximum of riding comfort, gliding along smoothly and noiselessly.

The tires, which are changed the same as in the case of an automobile, are inflated to 85 pounds per square inch, and have the appearance of twin tires with the tread fitting the top of the rail. The risk of danger from punctures was shown to be negligible by purposely deflating a tire while a coach was traveling at the rate of 50 miles an hour. As the load was being supported by the nine other wheels, the effect of the puncture was unnoticed, and the tire was changed in a few minutes on arrival at the next station.

Rail cars of this type may soon make their appearance in America, for the Edward G. Budd Manufacturing Company has acquired the rights to build them in the United States. In that company's Philadelphia plant there is now nearing completion what is said to be an improvement on the French model—an improvement largely made possible through the recent development by engineers of the Budd Company of a rustless steel that combines great strength with light weight. By the use of this metal the American manufacturer will be able to turn out a vehicle, so it is announced, that will weigh only 325 pounds per passenger as compared with 5,000 pounds per passenger for the average Pullman parlor car! The new rail car will seat 40 persons, and is expected to attain a maximum speed of more than a mile a minute. Test runs are to be made over a stretch of track placed at the disposal of the builder by the Pennsylvania and Reading systems.

Investigations of a bed of rock asphalt discovered several years ago near Santa Rosa, N. Mex., have revealed that it far surpasses in extent any other of its kind known to exist in the United States. The deposit is twelve miles long and two miles wide, and is estimated to contain 8,000,000,000 tons—enough to provide paving material for centuries to come. A local company has been organized to exploit the field.

The Prospector Comes Back

O. A. FITZGERALD

Robert McRae, who gold-panned his way through the University of Idaho. Left—"Shorty" Harris, veteran prospector and discoverer of several mines, is back at his old calling.

THE year 1931 witnessed more panning and placering for gold and good old-fashioned prospecting throughout the West than has any corresponding period since the tumultuous era which started when John Marshall discovered gold in paying quantities at Sutter's Mill. This may seem strange, since it was proclaimed for many years that the old-time prospector had passed from the picture and that mineral deposits would hereafter be sought entirely by new-fangled scientific equipment, such as electric and magnetic indicators.

Despite his frequently reported demise, the prospector is back in the field using the traditional implements of his calling essentially as did the men who filled the mountains in the early days. Responsible for his return are the nation-wide industrial depression and the fact that prospecting always has been the poor man's method of mining. Every depression in recent history has stimulated mineral-hunting; and the fact that there has been more activity this past year than in any previous period of stress signifies that it must be a bigger depression. When jobs grow scarce, vast numbers of men choose to hit out on their own along the gold-rush trails rather than try to eke out a living selling "unemployment apples" or seek aid from charitable institutions. In a way these old mining fields, which already have produced hundreds of millions of dollars in gold, are doing their bit to shorten the bread lines.

At the height of the big prosperity boom a few years ago, when jobs were plentiful and wages good, the writer visited one of the West's most historic placer fields. This basin had produced close to $50,000,000 from a comparatively small area. It had been worked over first by men whose tastes were so rich they thought ground no good unless it yielded many dollars of gold to the pan. Succeeding miners reduced their tastes; and, finally, Chinese miners were satisfied with several cents a pan. But even then they did not get all the gold. When the writer visited the place, two old prospectors were holding the fort. In its heyday, by way of contrast, the basin had a population of 20,000, a huge tent town. Vast expanses of upturned gravel, abandoned machinery and placer equipment amid a silence that gripped, bore mute testimony to the booming activity of other days. The surviving inhabitants were there because it was in their blood to stay, they would not be happy elsewhere. Without much trouble they could get enough gold to support themselves, and they wanted to live out their years where they could hear gravel grate against the sides of a gold pan and listen to the wind whistle through trees that had in the past supported a few "necktie parties" held under the auspices of vigilantes who decided that life in the diggings needed restraining influences. The two old-timers volunteered

Old-timers had to build long flumes to carry water to their sluice boxes. These California gold hunters have motorized their operations. An old Chevrolet truck, on which is mounted a centrifugal pump, can move about much faster than the old prospector and his burro.

the information that they could point out numerous places where an energetic worker, willing to endure the back-breaking strain of manipulating a gold pan, could make reasonably good wages. They stated that they did not work particularly hard—and I stayed around long enough to believe it. Yet their summer earnings aggregated about $300 apiece, a rather handsome grubstake for the frugal prospector.

During the past year or two many men have remembered that basin and scores of other old placer grounds from California to Alaska. The situation in the Intermountain states is summed up very succinctly by Dean J. W. Finch of the Idaho School of Mines, who says: "There is more gold prospecting in the Intermountain region than at any time since the rush days of the early West." He made this summary after a trip through several states. Corroborative of this statement are the remarks by Dir. R. J. Grant of the United States Mint that "not since 1915 has there been so much activity in the various gold camps as there is today. Gold receipts at the Helena, Mont., office in 1931 were twice as large as in 1930. The Boise, Idaho, office last year trebled its 1930 intake."

It was estimated that in California last year close to 10,000 men were out looking for the flakes of gold left by the early miners. Most of them were searching along the streams which figured in the rushes of '49; but San Francisquito Canyon attracted a horde. When the St. Francis Dam broke loose the great flood of water uncovered real pay-dirt deposits. To them have flocked men out of work. Some are experienced miners, wise to the tricks of separating gold from worthless gravel; but the majority are greenhorns lured by the thoughts of free gold which can be exchanged at the mint for cash. In the past few months many California prospectors have been inquiring about the chances of moving north. Apparently the field has become too crowded. Up and down the Pacific Coast the story is much the same. Old ghost towns have taken on new life. Men are learning anew the art of prospecting. Special impetus to gold hunters has been provided in Colorado, Idaho, and Canada. Each of these believes that all this scratching of Mother Earth's back will bring about some worthwhile discoveries.

It is not unusual for men to pick up substantial grubstakes during a summer at old placer diggings. A western university student realized $1,700 in six weeks with gold pan and rocker. Far back in the Thunder Mountain district of central Idaho, scene of an early rush which netted many millions, he browsed over the trails of old-timers and found flecks of gold in a stream. He traced the colors in true prospector fashion to pay gravel on a hillside above. By packing the gravel on his back down to the stream he was able to pan out $3 or $4 of gold in ten hours. He built a simple rocker, such as the old sourdoughs used, and his earnings increased to $15 a day. Construction of a horse-drawn sled, or "go-devil", raised the returns another $10 a day. The lad kept improving his methods until he was getting $30 and $40 a day. His total clean-up was seven and a half pint bottles filled with gold.

Several western technical schools are offering special instruction in the rudiments of metallurgy to enable practical men in the hills to make simple tests of minerals they discover, thereby eliminating the inconvenience, delay, and expense of sending specimens back to civilization for assaying. For a number of years the Colorado School of Mines conducted a prospector's short course during the summer. The attendance always increased in times of economic unrest. Even veteran gold seekers turned students for a few weeks to improve their fitness for the quest.

So many new gold hunters in Colorado have brought small quantities of gold to the United

The kit of the 1931 prospector contains a variety of tools. The man at the right is using a frying pan in lieu of a gold pan. He has a magnet from an old telephone to extract the iron. The stream being worked saw considerable activity in the early boom days.

States mint at Denver that it has amended its regulations and agreed to accept lots as small as 2 ounces. This was a distinct help to the 1931 model prospector, as anyone who accumulated about $40 in dust or metal could get his cash at once.

The closing of a Colorado industrial plant last year put nearly 100 men on the rolls of the jobless. Several of them took to the hills with gold pans and, by dint of hard work, managed to make wages. News of their activities filtered back to their former working associates, and within a few weeks virtually all of them had taken up the vocation of placering.

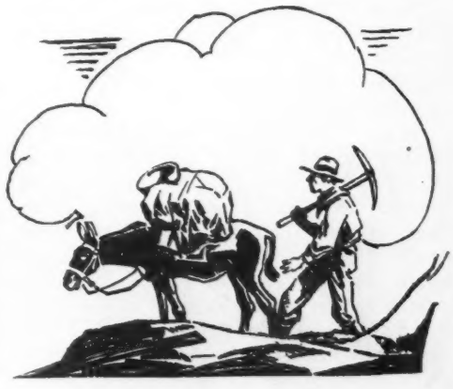
One of the old-timers of central Idaho's gold-rush days—that developed such camps as Florence, Buffalo Hump, Thunder Mountain, and Pierce City—used to wave his hand majestically toward the mountains and say, "There's more gold left in those hills than has ever been taken out". The new prospectors are proving that there is plenty of gold left, although the bulk of it may be widely scattered and payments per pan are not running very high. Perhaps the best find of the year came from Idaho—a nugget worth $80. Every miner who knows about the wealth obtained in the early days is hoping to stumble across some rich pocket overlooked by those ahead of him.

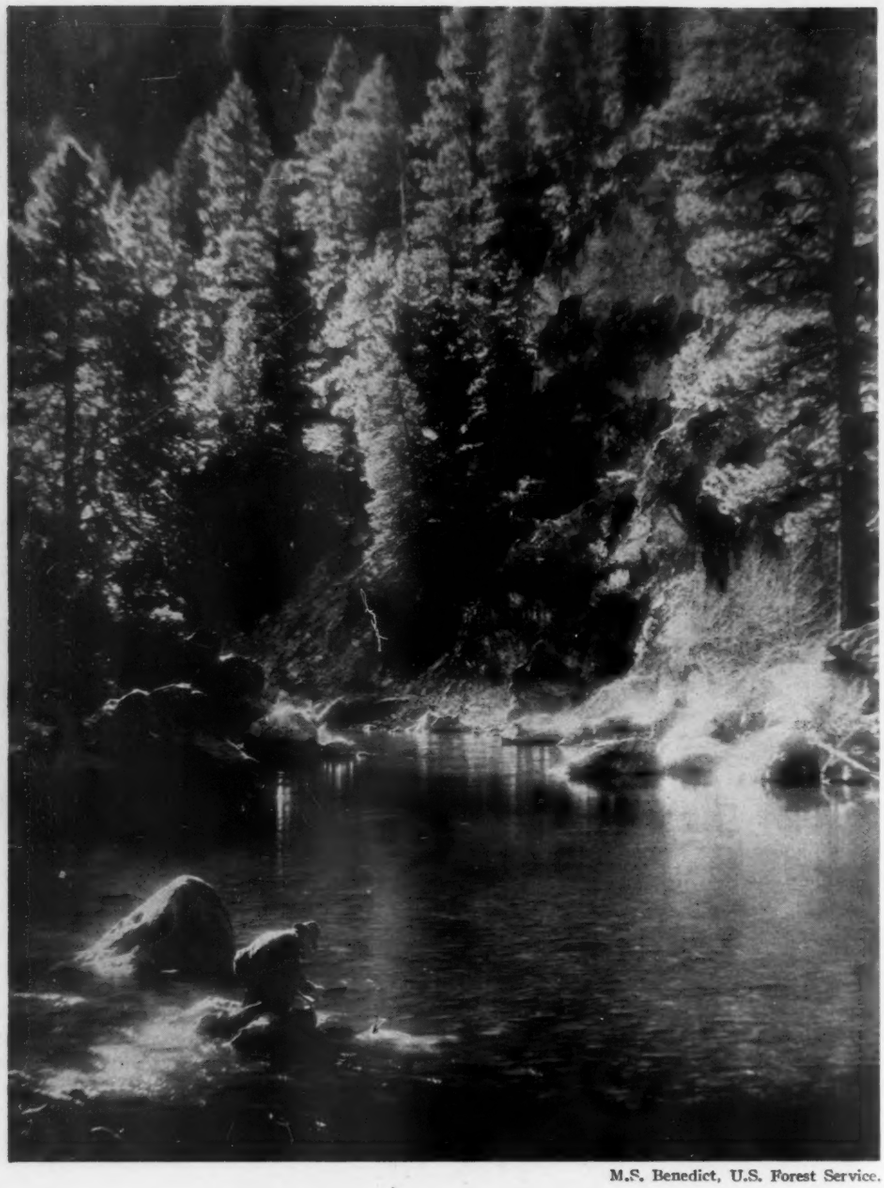
Revival of gold mining is reported from the old Gold Hill placer districts of southwestern Oregon. From Nevada come stories of hundreds of jobless invading the mineral fields to stay until times get better. There has been quite a stir up at historic Alder Gulch and in the Bannack camps of Montana. The burro market has been booming in Montana, and dealers report more demand for gold pans than since about 1900. The earth in these old camps, which has not been disturbed for a long while, once more is feeling the touch of pick and shovel. Up in Canada much impetus is being given this prospecting movement. The Canadian authorities desire to keep mineral hunting at a high level. Alaska is witnessing real signs of a comeback in prospecting, activity there being greater than at any time since 1900. The authority for this statement is Col. Charles Lindbergh, who, following his flight there, commented on the extent of it.

If the old sourdoughs, who a century ago roamed through British Columbia and took millions from the placer mines of the Cariboo, thought they got all the gold they were woefully mistaken, declares Dean R. W. Brock of the University of British Columbia. "They took out millions but left hundreds of millions. Intensive developments and more modern methods may be expected to yield a vast treasury of gold". W. A. MacKenzie, Minister of Mines, points out that placer-gold production increased last year and that there will be a still further increase this year. On Rainbow Creek, British Columbia, a small village has sprung up on a spot which only a few months ago was a wilderness. Gold has been found there. Men are getting as high as $16 a day picking and washing the gravel.

The British Columbia Chamber of Mines has issued a special publication to guide its vast army of new prospectors. Frank W. Woodside, manager of the organization, declares that the province has "immense placer fields to develop, and it is necessary to educate new men. The old placer miners and prospectors have nearly all died. There has been little activity in the field for the past 30 years".

The Idaho School of Mines has been able to chart the steady rise of interest in prospecting. Early last year the school began receiving letters concerning prospecting and placering opportunities. The queries were pretty much the same. The writers said they were out of work and wanted to know which of the old placer districts would be most likely to yield a few dollars a day from pan-





M.S. Benedict, U.S. Forest Service.

A 1931 gold hunter in a picturesque setting—the South Boise River near Featherville, Idaho.

ning, what equipment was needed, and other fundamental facts. After answering several hundred such letters, the school, to save time, compiled for free distribution what amounted to a condensed handbook on prospecting and placering. As soon as it was issued, calls pyramided. Fifty or more requests came every day. Already the publication has had five editions. Normally, an edition of a mining bulletin is sufficient for five years' demand, reports Dean Finch.

As might be expected, this new interest in prospecting and panning has resulted in the West's vast store of lost-mine legends being brought out once more for examination. Some of the prospectors definitely are out in search of the "big money" which these lost mines are supposed to represent. Every mining district has its share of stories about mineral deposits of incredible value that were supposedly found once under rather romantic and mysterious circumstances only to be lost and never relocated. All, like that of the famous Mother Lode of California, are very alluring, especially to newcomers in the prospecting game. It is quite apparent that after half a century these legends still fire men with enthusiasm.

Not all the men in the hills are westerners. Some hail from the Atlantic seaboard. The whole nation is represented in the gold camps. An old sourdough seeking companionship inserted an advertisement in a Boston paper for someone to join him in a search for a lost mine. Responses were plentiful, and amid a fanfare of publicity a young easterner started West for a summer along the gold-rush trails.

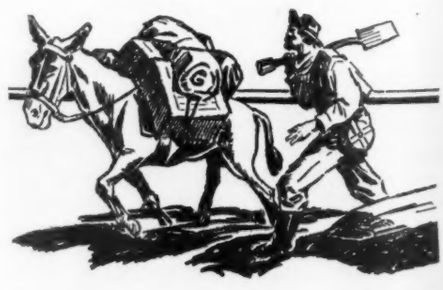
While the western states are doing everything they can to help out their would-be prospectors, the Federal agencies are issuing words of warning to the large number who inquire every day about chances for finding enough of the yellow metal to tide them over the period of hard times. Officials of the Geological Survey and the Bureau of Mines report it a lean day when less than ten to twenty letters arrive. Most of the queries come from areas where gold is found principally in watches and jewelry. The Government agencies are giving the applicants information that will prove helpful, and extending "good wishes".

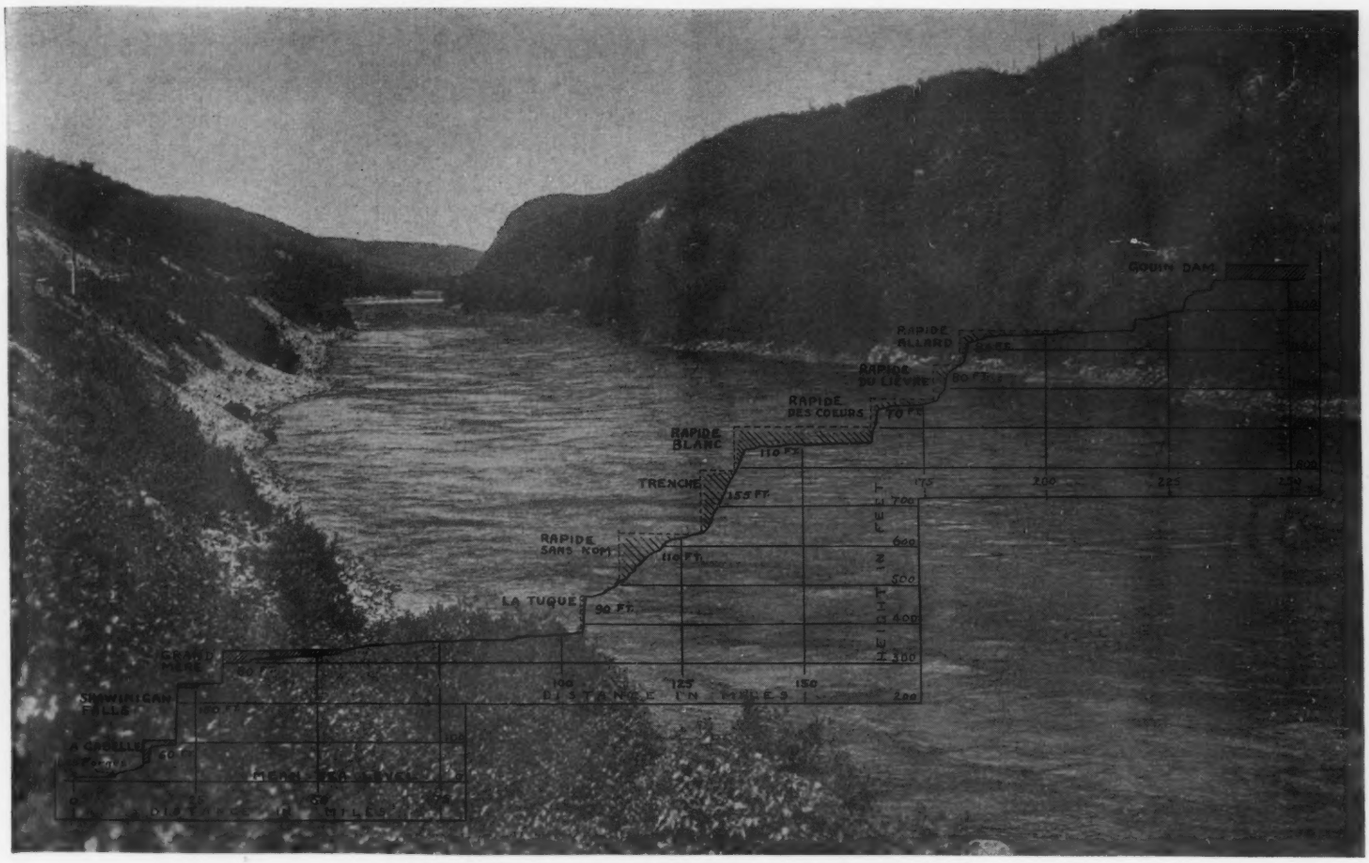
While the Government experts may point out that a prospector lacking scientific knowledge finds it difficult to make a living in districts that have been so thoroughly combed, history shows that some of the greatest discoveries have been made by men comparatively ignorant of the proper procedure. All of which recalls the old saying that "gold is where you find it". The depression of 1893 to 1897 sent prospectors and jobless to the mountains and resulted in the rich discoveries of the Klondike, Nome, and Fairbanks.

The amateur prospector was helped somewhat last summer by the drought. Streams were lower than for years past; and he was able to reach many bars and deposits that are normally not accessible. For example, the great Salmon River in Idaho, which flows through the great mineralized belt of the state and which has lured prospectors for generations, was abnormally low, and gold seekers could examine some bedrock accumulations that are usually out of reach. Shortage of water, on the other hand, was not conducive to efficient and speedy placering.

Regardless of whether this great prospecting wave results in any discoveries of lasting consequence, the historic placer fields are playing an important part in helping to meet economic difficulties. This is the second big contribution to their credit, as it will be remembered that gold from the rich placer fields and mines of the far West, which were in their prime at the time of the Civil War, was a great stabilizing factor to the Union during that period of conflict.

The chances of these modern prospectors obtaining vast riches are not so bright. It is estimated that after a promising discovery is made, only about 1 in 100,000 becomes a real paying property. However, this does not appear to be of immediate concern to the majority who are now in the field. Their principal objective is to swish out of the gold pan or rocker every day enough particles of gold to support them through the days of stress. After the hard times are over most of them will return to other endeavors, and the old placer fields will be left to rest until we have another depression.





A scene on the St. Maurice River, and a surprinted sketch showing present and projected power developments which will produce a total of 2,000,000 hp. of energy.

St. Maurice River Power—a Mighty Force in Canadian Industry

W. M. GOODWIN

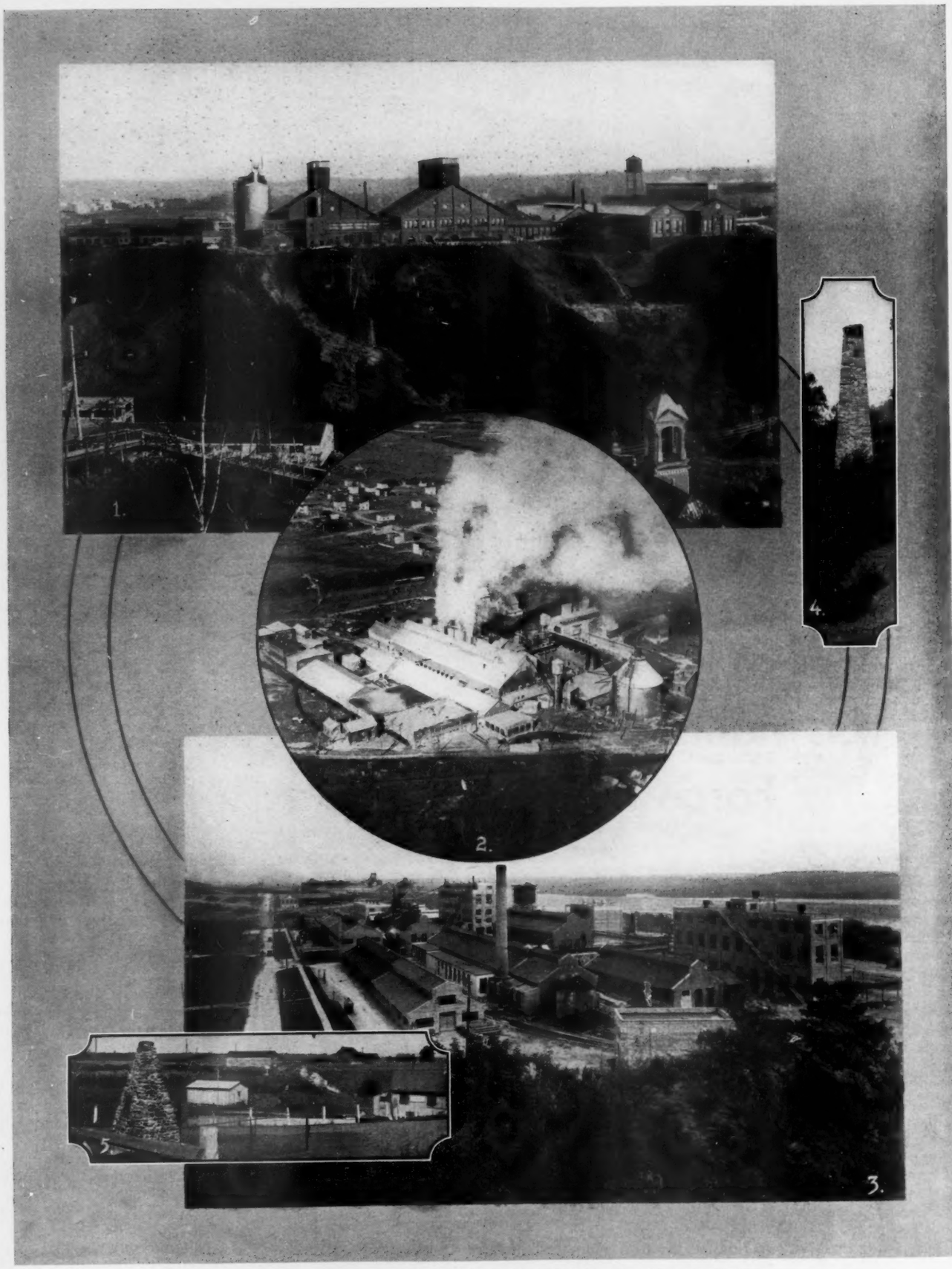
THE Saint Maurice Valley in Quebec, the cradle of Canadian industry, is now coming into its own again after half a century of eclipse. Its first fame rested upon beds of iron ore and supplies of charcoal that yielded to the early colonists an abundance of iron and steel. Its present development rests upon an immense block of electrical power which has made it of prime importance once more in Canadian industry.

Two centuries and a half ago, when the settlement in Canada consisted only of the fortified towns of Quebec, Montreal, and Three Rivers, and of scattered hamlets along the banks of the St. Lawrence, the mineral resources of the colony commenced to attract attention. In 1670, Talon, the great intendant of the French régime, reported to his royal master, Louis XIV, that there was an abundance of iron around Three Rivers, and recommended that forges be erected to meet the colonists' needs for iron. But the king had little time and less money for his far-off colony, and Talon's recommendation was carried out only after a lapse of 60 years.

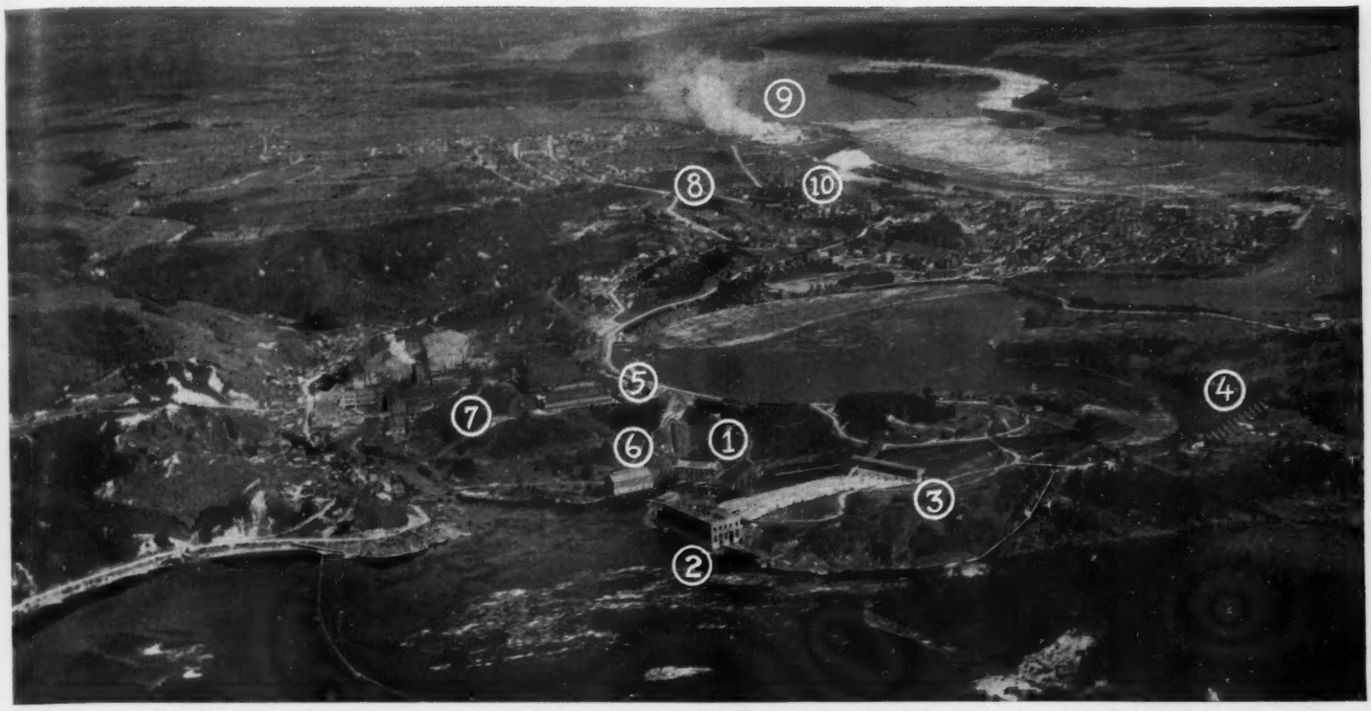
In 1730, Louis XV sent out from France money and skilled workmen to put up forges on the St. Maurice, and gradually there arose on the shore of the river, a few miles above its branched mouth at Three Rivers, the works that remained the chief industrial activity of the colony for 150 years. The records of the French régime hold many references to the St. Maurice forges. At first the workmen were able to make only cast iron—which they used for kettles, stoves, and cannon—because they lacked the skill to puddle the iron into steel. But in 1739 a skilled artisan was brought from France who taught them the art of making steel, and the forges gradually grew in importance until, at the time of the British occupation in 1760, they supplied the modest needs of the civil population and the military forces.

A glimpse of the forges at this time would disclose a busy scene—rude wagons loaded with ore dug from the bogs; more loaded wagons from the charcoal burners' heaps far in the forest; men charging the ore and charcoal into the top of the furnace from barrows, and others tending the water wheel and bellows that induce a draft at the bottom. Periodically the founders tap out the hot metal into ladles and pour it into their molds for kettles or cannon. Nearby is the puddling furnace where the iron is worked into steel. All told some hundreds of men were employed in this highly important industry. These activities continued through numerous vicissitudes until 1880; and some neighboring furnaces of a later date kept on past the turn of the century. But eventually operations ceased on account of the dwindling supply both of charcoal and of iron ore.

Let us now glance at the modern industrial scene that has taken the place of that envisaged by Talon in 1670. It is founded primarily upon an everlasting resource—the water that flows down the St. Maurice. It is only a little river, as Canadian rivers go; but it has been so endowed by Nature and improved by man that already it yields from only four of its falls nearly 1,000,000 hp., while another 1,000,000 hp. will be developed



Contrasts between ancient and modern industrialism. Views 1, 2, and 3 show, respectively, the works of the Northern Aluminum Company, the carbide plant of The Shawinigan Chemicals, Ltd., and the chemical plant of the same concern, all located at Shawinigan Falls. 4—Stack of an iron forge that began operations as far back as 1730. 5—Memorial cairn built of stones from Canada's first forge.



Aerial view of Shawinigan Falls, where electrical power has fostered great industrial activity. 1—New power plant. 2—Old power plant. 3—Water intake for power plants. 4—Diversion dam. 5—Northern Aluminum Company's plant. 6—Northern Aluminum Company's power plant. 7—Belgo Pulp & Paper Company's mill. 8—Shawinigan cotton mills. 9 and 10—Carbide and chemical plants of The Shawinigan Chemicals, Ltd.

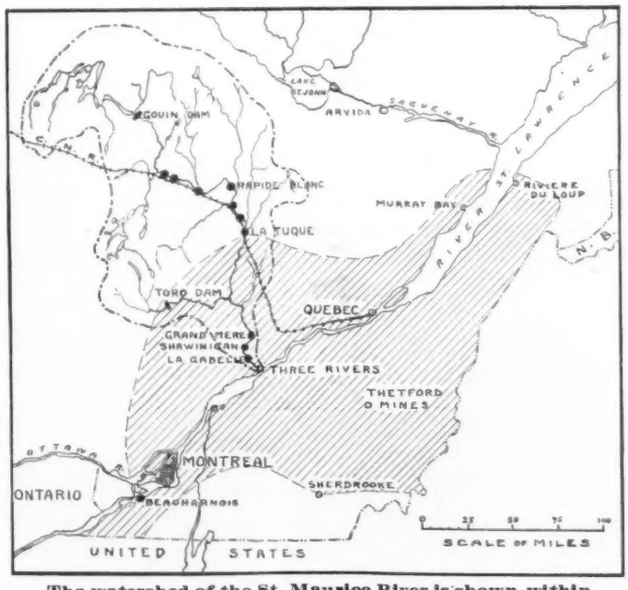
soon on its upper reaches. While the power of the St. Maurice is drawn upon largely to serve the needs of some hundreds of municipalities in the most thickly populated section of Quebec, including the Metropolis 90 miles away, it is the industries along the river that fulfill in the most striking way the expectations of Talon, though on a scale of which he never dreamt.

About one-quarter of the Dominion's pulp and paper output comes from seven mills which stretch along the St. Maurice from Three Rivers to La Tuque, 100 miles upstream. Their annual capacity is 800,000 tons of newsprint and 160,000 tons of kraft paper and pulp. The first of them was started 40 years ago at Grand' Mére; but most of its equipment, as well as that of the other mills, is of comparatively recent date.

While the mills at Shawinigan Falls, Grand' Mére, and La Tuque get their supplies of pulpwood mainly from the St. Maurice watershed, those at Three Rivers can, in addition, draw upon the thousands of miles of the lower St. Lawrence and its tributaries. All are served with power by plants at La Gabelle, Shawinigan Falls, Grand' Mére, and La Tuque. Part of this is direct water power, but most of it is supplied over an interconnected electrical system.

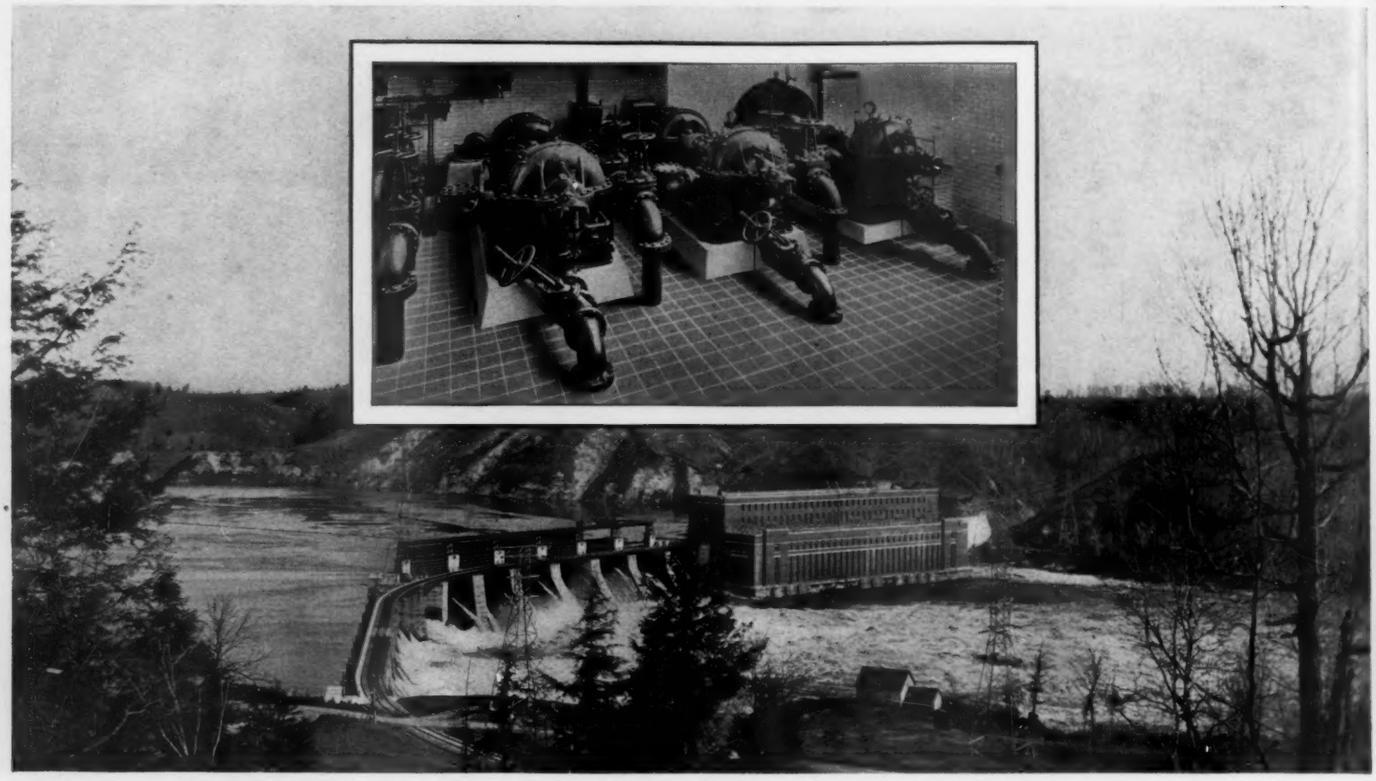
Much less widely known than the pulp and paper mills, but already of great interest and potentially of even greater value, are the industries centered at Shawinigan Falls. These combine common minerals and electricity to make an astounding variety of products. Until the giant plant at Arvida on the Saguenay was built five years ago, the Shawinigan plant of the Northern Aluminum Company was the only one of its kind in the country. More than half of the high-tension electric transmission lines in Canada are equipped with cables made there; and it is safe to say that most Canadian homes have some of its metal in their kitchens. But the bulk of the output is sent overseas.

Aluminum is made from bauxite, a clay-like mineral that comes mainly from British Guiana. After purification with chemicals, it is fed into a furnace filled with molten cryolite—another mineral which, when heated to a moderate temperature, will dissolve the bauxite much as water dissolves sugar. An electric current passing through the cryolite bath keeps it hot and separates out the metallic aluminum, which accumulates at the bottom and is drawn off from time to time. Scores of these furnaces or "pots" are in use continuously, consuming enough power to supply a good-sized city. The result is a supply of aluminum that serves Canada's needs and provides an exportable surplus worth some millions of dollars annually.



The watershed of the St. Maurice River is shown within the dotted lines at the upper left. The shaded area is served almost entirely by power from the St. Maurice.

The Canadian Carborundum Company, which also uses a large block of Shawinigan power, still holds the palm in that it is the largest plant of its kind in the world. Its product, consisting of artificial crystals that rival the diamond in hardness, has wide application. The whetstone of the Boy Scout, the "emery" wheel that sharpens the oft-dulled kitchen knife, or the oil-stone that edges the tools of those inclined to carpentering are all made of carborundum. During recent years the electrical industry has found another and very important use for that material. As it effectively resists the intense heat generated in many electrical devices it is now extensively employed for lining and covering them. Of late it has been discovered that carborundum makes an excellent electrical resistor, so it is now serving also as



The power plant at La Gabelle, where 150,000 hp. is developed from a 60-foot head of water. The insert shows three Cameron pumps which provide water-wheel-control service in the plant.

the heating element in those devices.

Carborundum is made from a mixture of sand, coke, sawdust, and salt. Only the first two enter into the composition of the crystals —the sawdust being added to make the mass porous so as to permit the crystals to grow to a large size. The salt is used to remove certain impurities. The sand is obtained by crushing and washing the purest quartzite rock obtainable—the company's quarries at St. Canute, north of Montreal, furnishing material well over 99 per cent pure. This gives a carborundum that is green in color and much in demand by the trade. As this plant produces many times the quantity of carborundum required for Canadian needs, the bulk of it is exported in the crude state.

The most startling transformations are those effected in the plants of The Shawinigan Chemicals, Ltd. Their raw materials are limestone, coke, electrical power, air, and water. Their products are multifarious, ranging from the most atrocious "stinks" to the most delicate perfumes, and from powerful explosives to the white wine vinegar that comes to our tables in salads. We often stop to wonder at the variety of dyes, perfumes, explosives, and so on, that come from coal tar; but here is an equally astounding and even more valuable assortment of chemicals derived from still simpler elements.

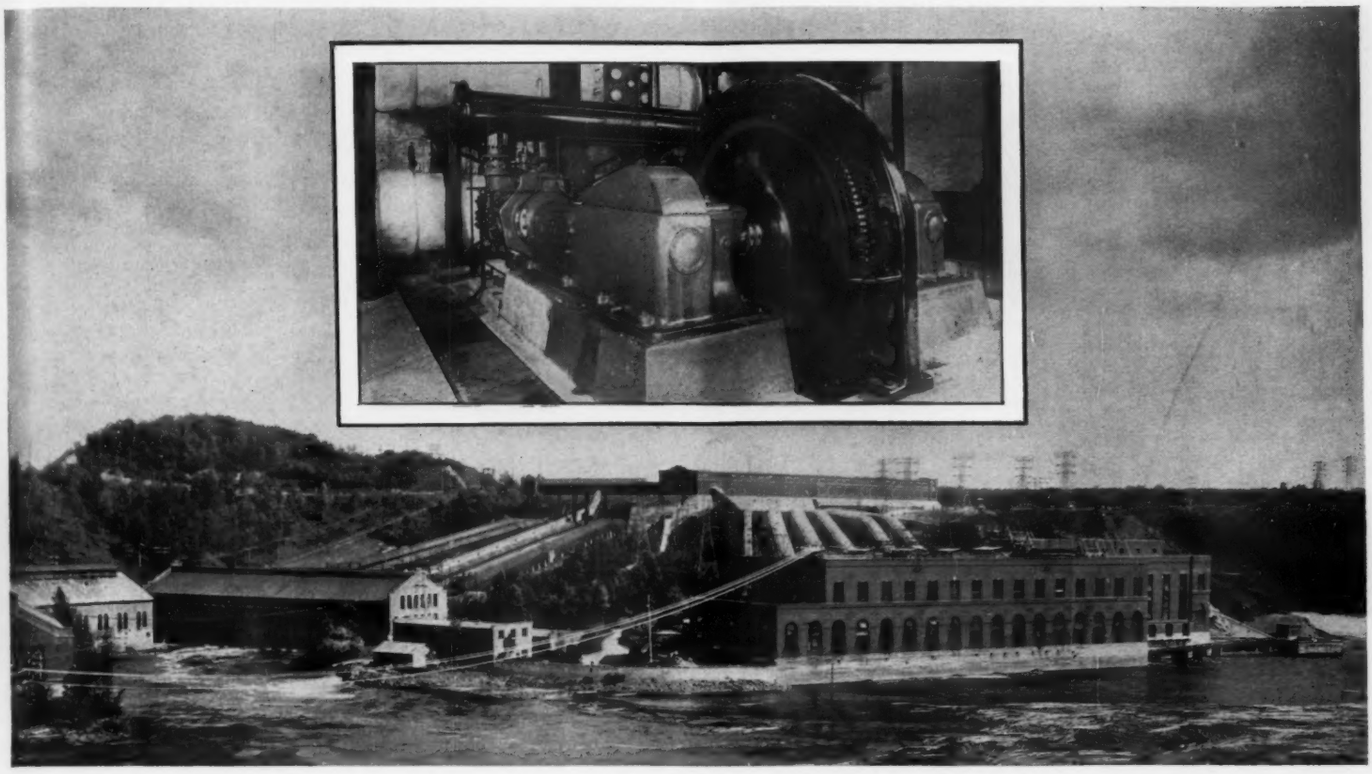
The first transformation in the long series that yields these products takes place in electrical furnaces where 20,000 hp. of energy is expended in a space no more than 12 feet across and 6 feet high. The almost unimaginable heat thus produced causes the calcium of the limestone and the carbon of the coke—fed in continuously at the top—to combine to form calcium carbide, which flows out intermittently at the bottom in a white-hot stream. Locked up in this calcium carbide is a store of energy, derived from the electrical power, that is used to advantage in many of the subsequent chemical transformations.

The most familiar use of carbide, as such, is in the lamps worn by miners in metal mines. A certain amount is still burned in somewhat similar lamps for bicycles. While much of the Shawinigan carbide is utilized in this country and abroad for these and similar purposes, about half of it is converted into acetylene gas on the spot. The greatest use of this gas is for oxy-acetylene welding and for cutting metals; but it also serves as the starting point in the chemical witchery that must remain forever a mystery to most of us. But before going into details regarding the chemical products, let us look back for a moment at the story of these plants, whose brief career constitutes one of the most interesting industrial romances of this or any other country.

Some of the old St. Maurice forges, from a print made more than 100 years ago.

It was in 1915 that the Imperial Munitions Board, faced with a serious shortage of acetone, dug out from the patent office at Ottawa some German applications that purported to tell how to make it from acetylene. Acetone is the liquid which, combined with guncotton, forms cordite—the explosive used in all British rifle and most of her artillery ammunition. No German patent rights could be allowed to stand in the way of an adequate supply of this essential munition of war: so an agreement was made with the Shawinigan company to attempt to apply this German idea.

There ensued a hectic year or more for the little group of chemists and engineers who were gathered hastily, some from civil occupations and some from the army, to accomplish this. One of the first things they discovered was that, if they followed the directions of the German patents, they would blow themselves to bits. With all their precautions there were many narrow escapes, for acetylene gas under pressure—the way they were using it—is highly explosive, and one of the trickiest explosives known. By dint of almost superhuman foresight and unflagging effort this little band of devotees succeeded in their attempt; and before a year was out the plant they had devised was turning out acetone by the ton. Cordite was again available in



These power plants at Shawinigan Falls generate 325,000 hp. from a 150-foot head. Insert—Class PRE ammonia compressor in one of the plants of The Shawinigan Chemicals, Ltd.

abundance, and the day was saved for the allies.

When the war ended, it looked much as if the usefulness of this synthetic acetone plant were ended, too. But again the little group of chemists came to the rescue. Jobs were scarce, and it was "root hog or die" with them. They "rooted" with such vigor that by 1922 they had turned over their wartime plant 100 per cent to peacetime uses, and, moreover, had so increased the efficiency of their process that less than 5 per cent of the equipment formerly required was needed in the new plant to produce the same tonnage. In other words, they had increased its efficiency more than twenty times, and so were in a splendid position to meet competitors in this and other lands. Several new chemicals were developed for which no uses were then known. The company went about the business of discovering applications for these with such ardor that it later became necessary to build a new plant at Niagara Falls to supply the American demand which had been built up for two such products. These researches and improvements have been continued, until today the principal products of The Shawinigan Chemicals, Ltd., can be sold profitably in practically any quarter of the globe—the output being regulated only by the needs of the market.

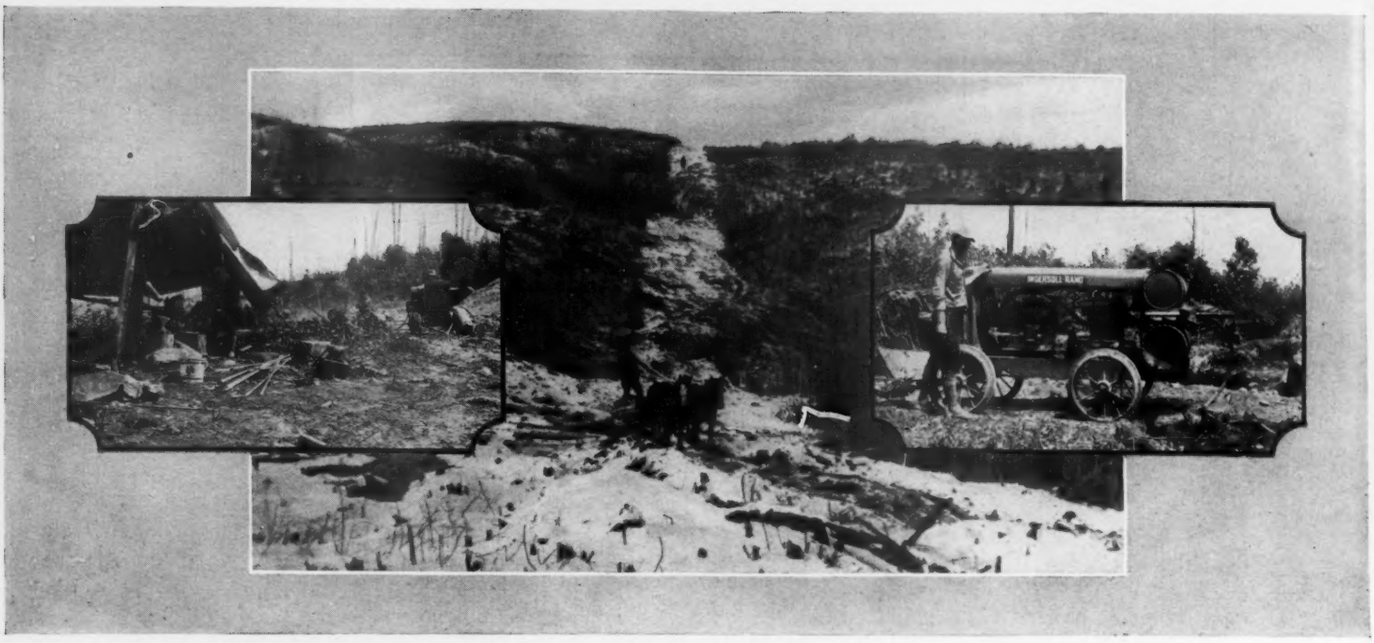
The chemical plant starts with acetylene gas piped across from the carbide plant. With the aid of pressure, heat, and certain substances called catalysts, there are added to it water and oxygen from the air, and thus the molecule is built up into a more complicated form. Acetic acid is the principal chemical so made at present. Large quantities of this and other solvents similarly derived are used in the manufacture of artificial silk, waterproof tissues, Duco, and many other similar materials. The familiar domestic use of acetic acid as vinegar calls for but a small fraction of the amount now produced. A list of the other products made reads like a Greek dictionary, and the number is being increased continually through research.

Formerly some of the acetylene, containing impurities as a result of the processes in the chemical division, was wasted. But recently all of it has been decomposed to give carbon black—the pigment in the ink with which this page is printed, and one of the principal ingredients combined with rubber to make tires. More than 90 per cent of the acetylene thus treated is removed as carbon black, and has proved a very useful by-product. Another offshoot from the chemical plant is illustrated by Shawinigan Stainless Steel & Alloys, a subsidiary founded two years ago. In its plant are made vessels required to withstand the corrosive action of acetic acid and other chemicals. The service has been extended recently to other Canadian plants, so they no longer have to bring these acid-resisting alloys from abroad.

We have left to the end the consideration of the natural resource that is behind all this development—the electrical power. As already mentioned, the St. Maurice is a comparatively small river; and it seems incredible that it should be capable of furnishing 2,000,000 hp. But its falls and rapids are such that almost all of the 1,000-foot drop from headwaters to tidewater can be utilized. Moreover, the conformation of the ground in several places has made it possible to create vast reservoirs by building small dams. By thus storing the flood waters for use in dry seasons, the useful flow of the river has already been trebled. As further storage basins are formed it will be still further augmented. This means that at Shawinigan Falls, for instance, where 100,000 hp. was formerly the maximum output, there is now being developed over 300,000 hp. at the expense only of more generating units. This, of course, means exceptionally cheap additional power.

The present power plants at La Gabelle, Shawinigan Falls, Grand' Mére, and La Tuque have a combined capacity of more than 700,000 hp. All are at sites that were developed at low cost from natural falls. The upper stretches of the

An old trading post on the river of Rats in the picturesque St. Maurice basin.



A clearing through the bush for an electrical transmission line. The inserts show a field blacksmith shop and Type 20 portable compressors which supplied air for drilling holes for poles.

river above La Tuque—where further development has been started—run mainly through a steep-sided valley and constitute a long series of rapids. In fact, there are so many good sites for dams that it is only a question of selecting the best. Construction is now underway at Rapide Blanc, which will furnish, when fully developed, 240,000 hp. When the natural profile of the river is finally converted into a series of level steps, as indicated in an accompanying illustration, the new plants will be capable of supplying over 1,200,000 hp., so that the total for the river will be approximately 2,000,000 hp.—the equal of the whole St. Lawrence flow at Beauharnois, and more than the present development at Niagara Falls.

All this development on the St. Maurice, with the exception of a small hydro-electric plant at Grand' Mére, has been accomplished during the present century. It was in 1898 that J. E. Aldred went north to Canada as a young man in search of adventure, and found his opportunity at Shawinigan Falls. Gathering a group of young Canadians around him, he plunged into the work of converting this part of the wilderness into a center of industry. Any citizen of the flourishing City of Shawinigan Falls today would look askance at a suggestion that he was in, or anywhere near, the backwoods. But in 1900 it boasted no railway, the roads were quagmires, and there were a few log buildings and what now would appear as modest construction crews working on the dam and power plant. Nor was the management any bed of roses, for in Montreal as well as in New York it was commonly considered that Aldred was a wild man to develop in this isolated locality the huge amount of 22,000 hp.!

But faith and perseverance won, in spite of obstacles that would have daunted a less determined group. Vivid stories of that time still circulate, as for instance how again and again, in periods of extreme difficulty, the paymaster came to trusted employees with the pay envelope in one hand and some Shawinigan share certificates in the other, asking them to accept the latter. Those with vision own today substantial interests in one of Canada's largest and soundest industrial enterprises, while the doubters have only vain regrets.

With less than half its available power developed, the St. Maurice is already the support of one of Canada's most important centers of primary industry. The materials produced are becoming to an increasing extent the raw materials of secondary industries which are, in consequence, attracted to the region. Thus the resources now serve the needs of the Canadian people much as the primitive forges served them for a century and a half in pioneer days.

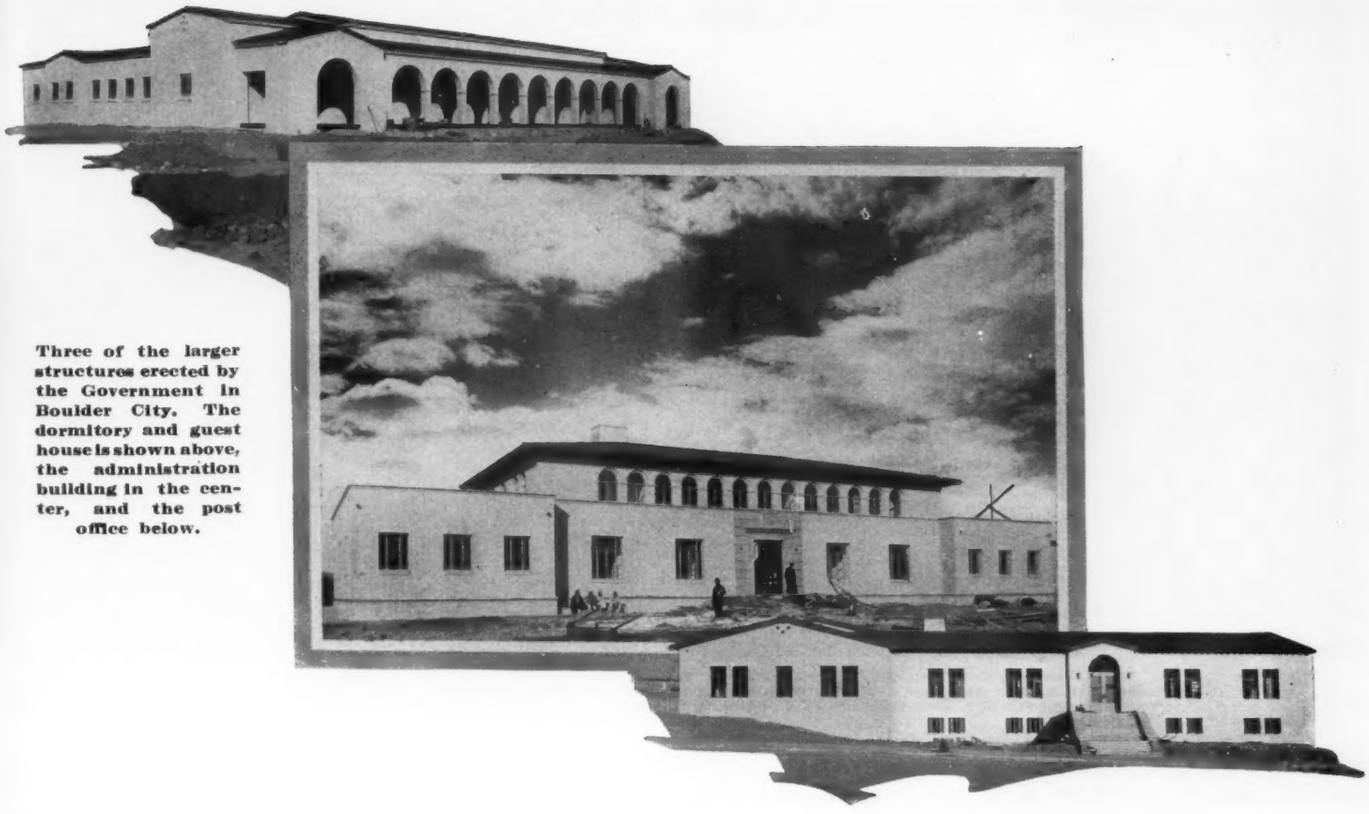
When the full power of the St. Maurice is harnessed and put to use, the scene of industry will exceed the hopes even of that group of youthful enthusiasts who founded the enterprises 30 years ago. Truly there is romance in the story of this little river.

Falls at Grand' Mere as they appeared before a power dam was constructed there.

ELECTRIC INSTRUMENT MEASURES CORROSIVENESS OF SOIL

FOR some years now the United States Bureau of Standards has been investigating the effects of different soils on underground pipe lines. Among other things, the Bureau has learned that soils high in soluble salts and consequently low in electrical resistivity are very destructive in their action if proper measures be not taken against them. Such soils frequently occur in the form of outcrops or pockets in areas that are otherwise normal or of high resistivity. It is therefore a matter of importance that companies building pipe lines should be able to predetermine readily the nature of the soils to be traversed so that the piping can be given protective coatings that will meet local conditions.

The outcome of these researches is an instrument that quickly measures on the spot the electric resistivity of the soil, thus obviating the taking and examining of samples. The new instrument is known as the Shepard earth resistivity meter. It consists of two rods or canes tipped with iron electrodes—the cathode being much larger in area than the anode to reduce polarization. One of these rods carries a flashlight battery and a milliammeter mounted in an aluminum frame. The rods are pushed into the earth about a foot apart. In that position, with the circuit closed, the resistivity of the soil can be read directly in ohm-centimeters on the scale of the instrument. Two scales are provided: one from 100 to 500 ohm-centimeters, and the other from 400 upward. The meter was developed by E. R. Shepard of the Bureau of Standards and is distributed by O. S. Peters, 930 H. Street, N. W., Washington, D. C.



Three of the larger structures erected by the Government in Boulder City. The dormitory and guest house is shown above, the administration building in the center, and the post office below.

Construction of the Hoover Dam

*Within a Year's Time the Government has Reared a Modern City in the Desert at a Cost of $1,600,000**

C. H. VIVIAN

BOULDER City Nev., is a municipal by-product of the Hoover Dam. Sired by Uncle Sam, and growing up under his watchful eyes, it is unique among American cities. A year ago the ground it occupies was desert waste. Today it is a community of more than 4,000 souls and some 600 buildings. It has paved streets, water, sewers, electric lights, and telephones. Soon it will have lawns, flower gardens, shade trees, and a park.

Even the Government is in doubt as to its ultimate size and prosperity; but its immediate future is assured by virtue of the clause in the Hoover Dam contract which requires 80 per cent of the employees of Six Companies Incorporated to live there during the construction period. After the dam is completed, nobody knows just what will happen. A certain number of Bureau of Reclamation men will be stationed there, and probably the employees of the power company that takes over the operation of the huge generating stations will also make it their home. As regards other permanent residents, the Government is only speculating; but it has reason to believe that the vast amount of publicity given the dam will draw homeseekers to the region and that the completed project will prove a magnet for tourists. At all events, the development plan visions an enduring town of 4,000 or 5,000 persons.

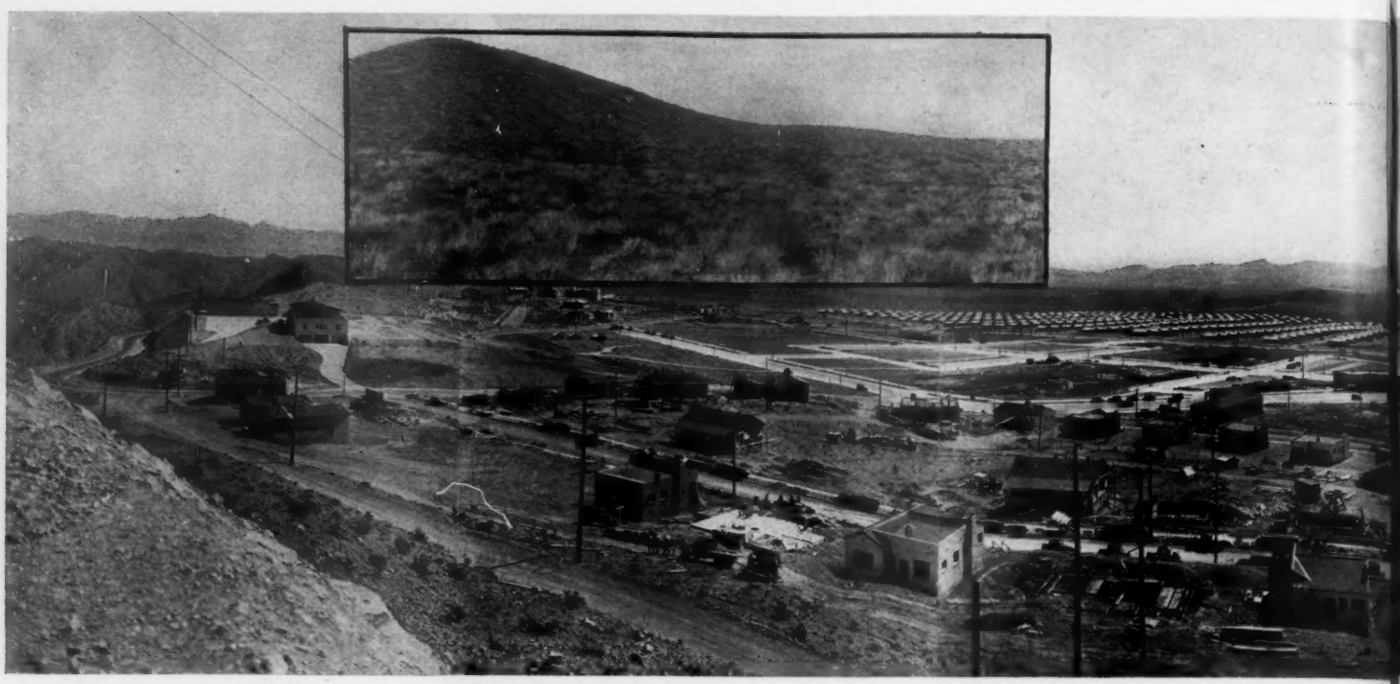
Boulder City is not the creature of whims or theories. It was born of sheer necessity. Bureau of Reclamation officials recognized that the Hoover Dam could never be reared in the midst of a desert unless precautions were taken to insure adequate care of the workmen. The bureau knew this because its own engineers had carried on in the blistering heat of many summers gathering the preliminary data required to locate and plan the structure now in the making. Their home was a cluster of tents which afforded little bodily or mental comfort. Fortunately, there were relatively few of them, and they managed to endure discomforts and to ward off pestilence. It would be out of the question, however, to house 3,000 men in this manner for six or seven years.

It would be a bit ironical, the Government thought, if the climatic restrictions proved too severe for American labor to carry through the largest single construction project it had ever attempted. And there were plenty of persons who predicted this would come to pass. Some prophesied that Orientals would finally have to be imported to cope with the melting temperatures that prevail in Black Canyon for four months out of the year.

To make certain that nothing of this kind would happen, Uncle Sam decided to extend a kindly but firm paternal helping hand to the contractors and to set up a construction town under his control to insure for the workers a high standard of living and a maximum of comfort and general well-being. The wisdom of this course is shown by the marked effect it had on the attitude of bonding companies. Two of these concerns sent an investigator to the dam site before the contract was awarded. This emissary sizzled in the canyon one day and then took back his report. It was enough. The companies let it be known that they had no interest in underwriting the performance bond required of the contractors, despite the fact that the premium promised to exceed $1,000,000. But when they learned the Government's plans for improving living conditions, they reconsidered the matter and ended by giving to the project a far lower rate than had been charged on many enterprises of smaller size.

The Government set aside $2,000,000 for

*Sixth of a series of articles on the Colorado River and the building of Hoover Dam.



Boulder City, as it appears from a hill to the north. In the foreground are residences for Government employees, residences of employees of Six Companies Incorporated. In line with them, at the right, are the contractors' dormitori building may be seen. The insert at the left shows the site of Boulder City as it looked early in 1931. The insert at t

the construction of Boulder City. Of this sum approximately $1,600,000 had been spent or contracted for up to March 1, 1932. Great care was taken in selecting a site. A town in the canyon itself was out of the question. There wasn't room for one, and the terrific heat during a third of the year forbade it. Dr. Elwood Mead, Commissioner of the Bureau of Reclamation, summed up the situation in the following words:

"In the summer the wind that sweeps over the gorge from the desert feels like a blast from a furnace. At the rim of the canyon there is neither soil, grass, nor trees. The sun beats down upon the broken surface of lava rocks. At midday they cannot be touched by the bare hand. It is bad enough as a place to work. It is no place for a boarding house or a sleeping porch. Comfortable living conditions had to be found elsewhere, and these are found on the summit of the divide, seven miles from the dam site. Here there is fertile soil; here winds have an unimpeded sweep from every direction; here there is also an inspiring view of deserts and lonesome gorges and lofty mountains. When the dam is completed and a marvelous lake fills the foreground, the view from Boulder City will be so inspiring and wonderful as to be worth traveling around the world to see." The city site has an average temperature lower than that at any of the others considered and several degrees lower than the temperature at the dam site. It is 2,500 feet above sea level, 1,700 feet above the river, and 1,250 feet higher than the top of the future dam.

During the life of the Hoover Dam contract, Boulder City will be a municipality with two distinct sections. It was told in a previous article in this series how Six Companies Incorporated has spent upwards of $800,000 for buildings that will be razed when the dam is finished. In contrast to these temporary buildings, the Government is providing the permanent structures of the town. These include, aside from the site itself, the various utilities such as water and sewer systems and street lights, also sidewalks, paving, parks, public buildings, and permanent dwellings for its employees.

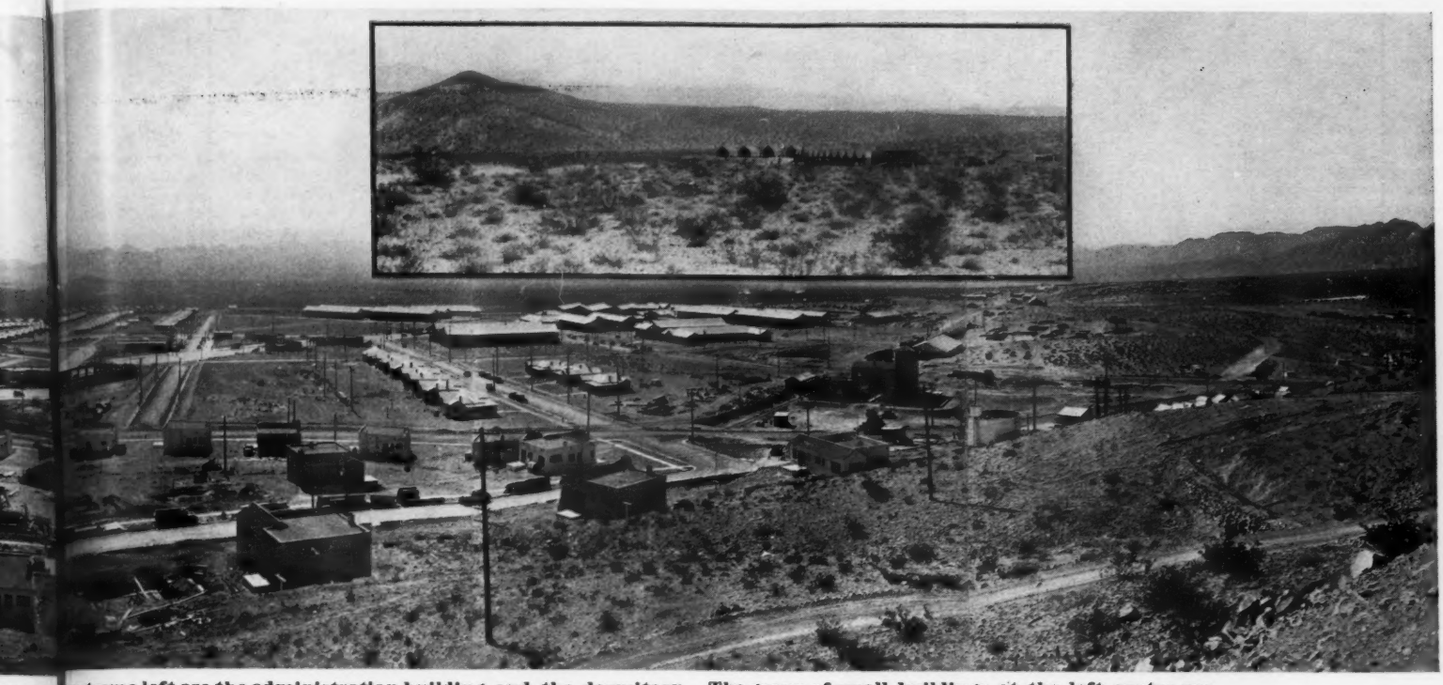
It was originally intended that Boulder City should be built largely in advance of the coming of the dam workers, who were to move into a spick-and-span town affording all conveniences. This plan was abruptly ended by the decision to speed up the dam contract to help alleviate the business depression. Thus it happened that when the contractors moved on to the job in March, 1931, the city was still in the blueprint stage. As a result, many hardships had to be borne during the first summer that adherence to the first plan would have averted. Happily, the next hot-weather period will find Boulder City better prepared for it.

The town site includes approximately 300 acres, and is laid out roughly in fan shape with the point at the north, where a ridge separates it from Hemenway Wash. The northern portion is allotted to Government buildings. Groups of residences for Bureau of Reclamation employees are arranged along the lower slopes of the ridge on either side of the fan point. Between these two groups are the administration building and the dormitory. Just below these, to the south, is a 5-acre park at the apex of an angle formed by the meeting of two principal streets. These thoroughfares diverge to the far corners of the city at the south and form the chief arteries of travel, with most of the town site between them.

The ground has a fairly uniform slope of about 3° from north to south. The central portion of the city will be devoted to business and commercial uses; the southern section is set aside for residences. Considerable areas in this district are now occupied by temporary frame houses for employees of Six Companies Incorporated. Most of the contractors' larger structures, such as dormitories, store, recreation building, etc., are on the western edge of the town, where they do not impede development of the central part of the city.

Boulder City was laid out by S. R. DeBoer, a well-known city planner, and is designed to be a model town. In the business section are being provided special plazas for the parking of automobiles, and no street parking will be allowed. Alleys in the commercial zone are laid out 50 feet wide to permit the loading and unloading of trucks in the rear of stores and thus to lessen their use of street space. Through automobile traffic will travel on highways which are separate and distinct from the business and residential streets. Streets will be graduated in width according to their intended usage. Through highways and business streets will be 92 feet wide, and residential streets 60 feet wide.

In the districts which are expected to have



extreme left are the administration building and the dormitory. The group of small buildings at the left center are ee buildings, etc. The business section of the city will be developed near the center, where the arcaded post-office at shows the tent camp, near Boulder City, which was the home of the Government engineers until a few weeks ago.

the greatest density of population, the blocks are laid out 900 feet long and 260 feet wide. In their design, provision has been made for interior plazas which will contain small parks. These can be equipped with playgrounds for small children and with croquet lawns and horseshoe pitching courts for elderly persons. The older boys and girls and the young men and women of the future Boulder City will find recreational facilities in the community park in the form of football, baseball, tennis, and other sports which are being planned for their amusement.

The Government's program of building, which is now well advanced, includes a $60,000 administration building, a $45,000 municipal building and post office, a $33,000 dormitory for unmarried workers and visitors, a garage and fire station, a schoolhouse, 100 residences of from three to seven rooms each for married employees, and several community garages. Durable materials such as brick, tile, and stucco are being used in the buildings, all of which follow the Spanish type of architecture. The larger structures have furnaces, and the administration building is equipped with an air-conditioning system. Landscaping, and the planting of trees and lawns, have been started. When completed, these various items will have cost some $600,000.

During the past autumn and winter, the New Mexico Construction Company of Albuquerque, N. M., has been carrying out a $300,000 contract covering the installation of water distribution and sanitary sewerage systems; the grading of streets, alleys, and automobile parking spaces; the laying of concrete curbs and gutters and of concrete and gravel sidewalks; and the paving of certain streets and the surfacing of others. This work involved, among other operations, more than 23 miles of trenching for pipe lines, 151,000 cubic yards of excavating, and the laying of 90,000 square yards of asphaltic-concrete pavement.

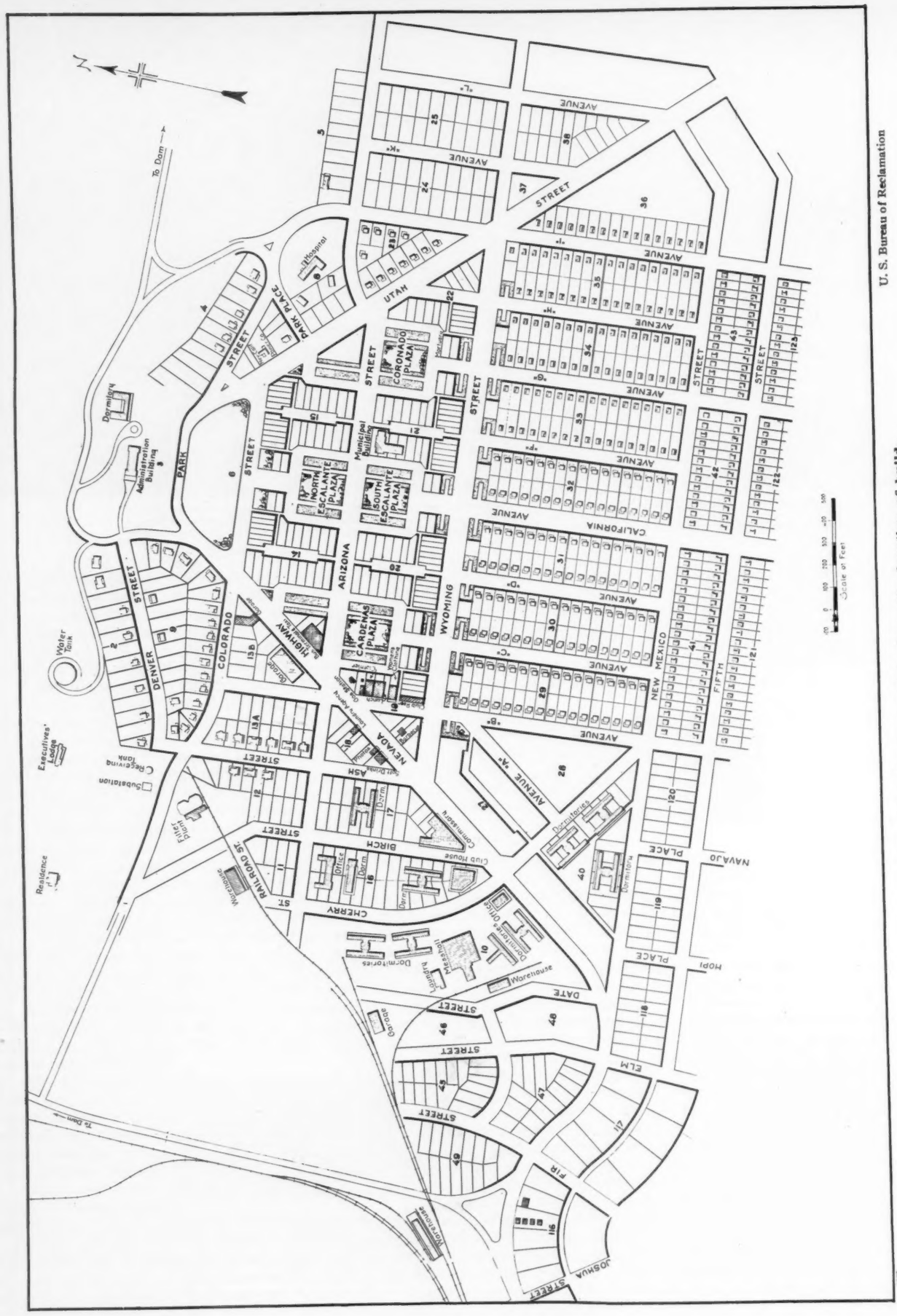
One of the major tasks in connection with the building of Boulder City was the provision of an adequate supply of pure and palatable water. This was done at a cost of approximately $500,000 by installing equipment to pump Colorado River water more than six miles, elevate it nearly 2,000 feet, remove the discoloring sediment it carries, soften it, and treat it chemically to render it thoroughly safe for human consumption. A supply of greater initial purity could have been obtained by driving wells to tap the artesian reservoir beneath Las Vegas and the adjoining area, but cost and economic studies indicated that the river water could be developed at less expense.

The intake is just below the outlets of the diversion tunnels, roughly half a mile below the dam site. Three centrifugal pumps elevate the water about 100 feet to a 200,000-gallon pre-sedimentation clarifier. The pumps are mounted on a car which may be lowered or raised on rails of 47° slope, making it possible always to take water from a zone 4 feet beneath the surface, regardless of the stage of the river flow. Most of the sediment settles out readily, and the retaining of the water up to three hours in the pre-sedimentation basin serves to remove about 95 per cent of the solid matter. A Dorr traction clarifier mechanism, having a capacity of 62 tons of dry solids a day, removes the sludge which settles out.

Two lifts or stages of pumping are required to raise the water from the clarifier to the treatment plant at Boulder City. The pumping equipment at both stations consists of three 4-stage, 450-gallon-per-minute, 1,200-foot-head centrifugal pumps. The lower units force the water through 20,000 feet of 10- and 12-inch steel pipe to a booster station almost 1,100 feet higher. The second bank of pumps, which takes its supply from a surge tank 90 feet high, pushes the water through 14,500 feet of pipe and raises it 850 feet to a 100,000-gallon tank in Boulder City. Extensive treatment and filtration equipment is installed there to soften the water and further to clarify it. Following filtration, the water is chlorinated and pumped to a 2,000,000-gallon storage tank on a high knoll just north of the town. Three 500-gallon-per-minute, 170-foot-head pumps serve to give it this final lift of 150 feet. All pipe in the system is buried approximately 3 feet deep.

The system was designed by Burton Lowther, of Denver, consulting hydraulic and sanitary engineer to the Bureau of Reclamation. It was built under a number of contracts covering its various phases.

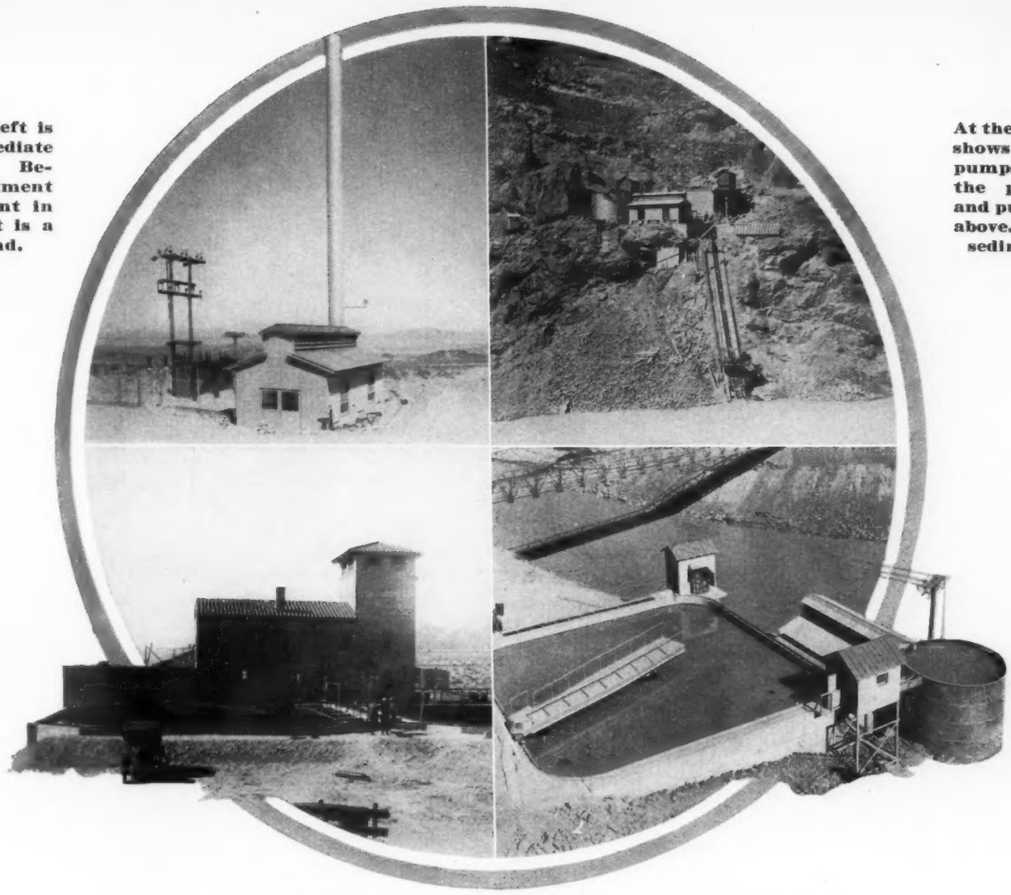
River water, untreated except for pre-sedimentation and chlorination, was delivered to the storage tank for the first time on September 9, 1931, thereby providing an emergency supply for the city. Up to that date, Six Companies Incorporated had been hauling water in tank cars from Las



U. S. Bureau of Reclamation

Plan of Boulder City which shows the location of buildings erected or in course of erection. Most of the structures at the left and in the lower section of the city are used by Six Companies Incorporated and their employees.

Top view at the left is of the intermediate pumping station. Below is the treatment and filtration plant in Boulder City that is a model of its kind.



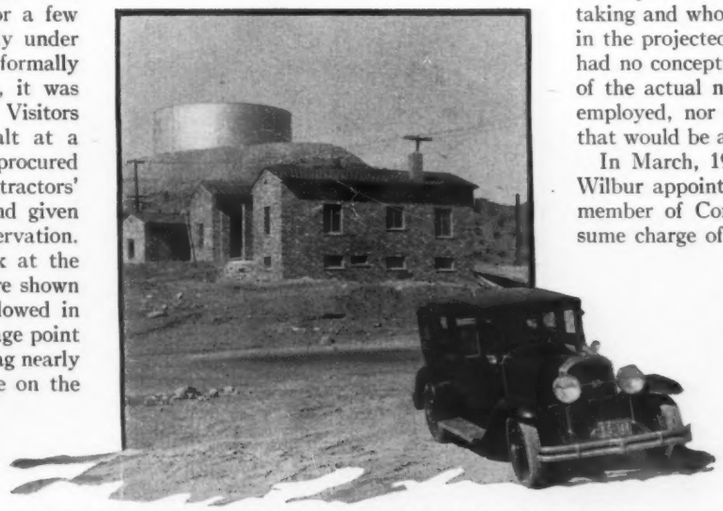
At the right the top view shows the movable pumps at the river and the pre-sedimentation and pumping structures above. Below is the pre-sedimentation basin.

Essential structures in the Boulder City water-supply system.

Vegas. The daily consumption during the torrid summer months was as much as 50,000 gallons, and cost from half a cent to three-quarters of a cent a gallon. The city distribution pipes and the treatment plant were not installed until months later, so that the water system was not functioning in its completed form until February, 1932. A sewage-disposal plant is being constructed about a quarter of a mile from the city limits.

An area of 110 square miles, of which Boulder City is a part, was withdrawn from public entry in 1921 and, except for a few pieces of patented ground, is entirely under Government control. While never formally declared a reservation by Congress, it was established under Nevada statutes. Visitors approaching Boulder City must halt at a sentry station, and passes must be procured before proceeding further. Contractors' workmen are hired in Las Vegas and given credentials to admit them to the reservation. Sight-seers bent upon having a look at the construction drama in the canyon are shown every courtesy, but they are not allowed in the working zone. The nearest vantage point for them is Lookout Point, a rocky crag nearly 800 feet directly above the dam site on the Nevada side, where a place of observation has been established.

The Government intends to retain jurisdiction over all the land in Boulder City during the construction period in order that it may have full control of activities there. No business or professional enterprise can be established in the town except under Government permit. Land for business or residential purposes cannot be bought, it can only be leased; and structures built thereon must be approved from the plans before construction can start. Leases run for a maximum of ten years, being limited because of the uncertainty of Boulder City's status after the dam is completed. The future disposition of such leases will be determined upon their expiration. They may be extended, or the land may be sold.



Some Government residences and, above them, the 2,000,000-gallon water-distribution tank on a hill above Boulder City.

Establishment of these stringent regulations was deemed advisable to prevent a wholesale influx of people, with consequent unemployment, ruinous business competition, and widespread infractions of laws. Even before the dam contract had been awarded, the Bureau of Reclamation was deluged with inquiries from persons in all parts of the country who had read of the great undertaking and who desired to engage in business in the projected town. Most of these people had no conception of the climatic conditions, of the actual number of men that would be employed, nor of the business opportunities that would be available.

In March, 1931, Secretary of the Interior Wilbur appointed Louis C. Cramton, former member of Congress from Michigan, to assume charge of the appraisement of lands in Boulder City and of the making of lease concessions. Mr. Cramton formulated regulations governing the granting of permits for conducting business and for leasing ground, and these he published in a pamphlet together with a general description of conditions that would be met with in the construction town. This information was issued

on May 18, by which time more than 3,000 letters of inquiry had been received and placed on file by Jesse W. Myer, chief of the mail and files section of the Bureau of Reclamation, who had been detailed to Las Vegas to classify them for handling. Additional mail inquiries were coming in at the rate of fifteen a day, and as many more persons were calling at the Las Vegas office. It having been decided that only formal requests for permits would be considered, a pamphlet and an application blank were sent to each inquirer. A $10 fee to show good faith was required with each application, the sum to be returned if no permit were granted. The informal inquiries continued in volume and totaled more than 4,000 up to October 1, 1931, but on that date only 320 persons had returned the official blanks accompanied by the fee.

The system adopted effectively curbed a mushroom growth and undoubtedly averted confusion, disappointments, and hardships. Said Mr. Cramton at the time the regulations were drawn: "There is no doubt that, if the Government desired, it could create in Boulder City in the next year one of the most spectacular boom towns in recent history. If we were to reply to inquirers without discouragement and without limitations, simply setting aside the necessary lots for business and residential purposes, I have no doubt a thousand or more persons would sell out what they have at home and go to Boulder City expecting to make their fortunes there. Ruin would inevitably follow any such movement, for the business possibilities are limited. Certainly the Bureau of Reclamation does not desire to have any part in such wholesale business disaster."

Formal applications for business permits were received from persons in 36 states and covered more than 60 types of business, ranging in alphabetical order from automobile sales to welding. Had all who applied set up establishments, there would have been in Boulder City 31 drug stores, 21 indoor recreation rooms, 16 barber shops and beauty parlors, 14 restaurants, 14 filling stations, 12 soft-drink shops, and innumerable stores of other kinds. To guard against such overcommercialization, the Government set up four classifications to guide the granting of permits:

1. Exclusive—Public utilities and similar operations. Only one permit for each classification.

2. Limited—Mercantile stores, such as groceries and markets. At least two competing permits in each line.

Sims Ely, city manager of Boulder City.

3. Special—Banks, motor lines to outside points, etc. The number of permits to be governed by the prevailing conditions.

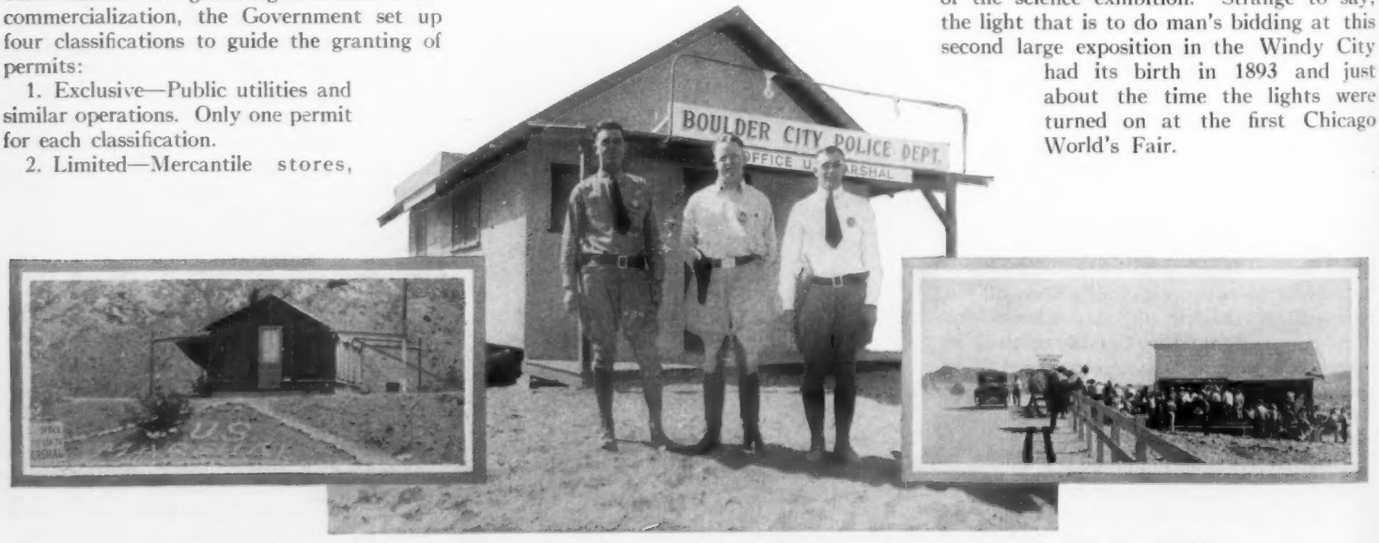
4. Personal—Professional services such as doctors, lawyers, and dentists. Permits to be granted subject to authorization in the states where the respective applicants reside.

The field for business enterprises is narrowed through the fact that Six Companies Incorporated maintain various retail establishments essential to the needs of their employees, including a dining hall, department store, recreation hall, laundry, and barber shop. A business permit carries with it the right to lease ground for business purposes. The average annual rental for a business lot 40x120 feet is $275. Any person of good character may lease ground for residential uses at an average annual rental of $120 for a lot having a 50-foot frontage.

Up to March 1 of this year 114 business permits had actually been granted, and 26 retail and wholesale establishments had been set up. Buildings erected or in course of erection for these purposes totaled eighteen. Twelve permits to lease residential lots had been issued, and two homes had been built or were under construction.

Sims Ely, of Arizona, heads the administrative staff of Boulder City as city manager. He was appointed by Secretary Wilbur and reports to Walker R. Young, construction engineer in charge of the project for the Bureau of Reclamation. He is assisted in governing the town by an advisory board of three men, of whom two represent the Government and one represents the contractors.

The policing of Boulder City, as well as of the entire reservation in which it is located, is in the hands of deputy United States Marshals. A force of nine men is headed by a chief ranger. G. E. Bodell is chief of police of Boulder City. Laws prohibiting gambling, the sale of liquor and narcotics, and other practices which the Government deems injurious to the workers and to the orderly progress of the work in the canyon are rigidly enforced.



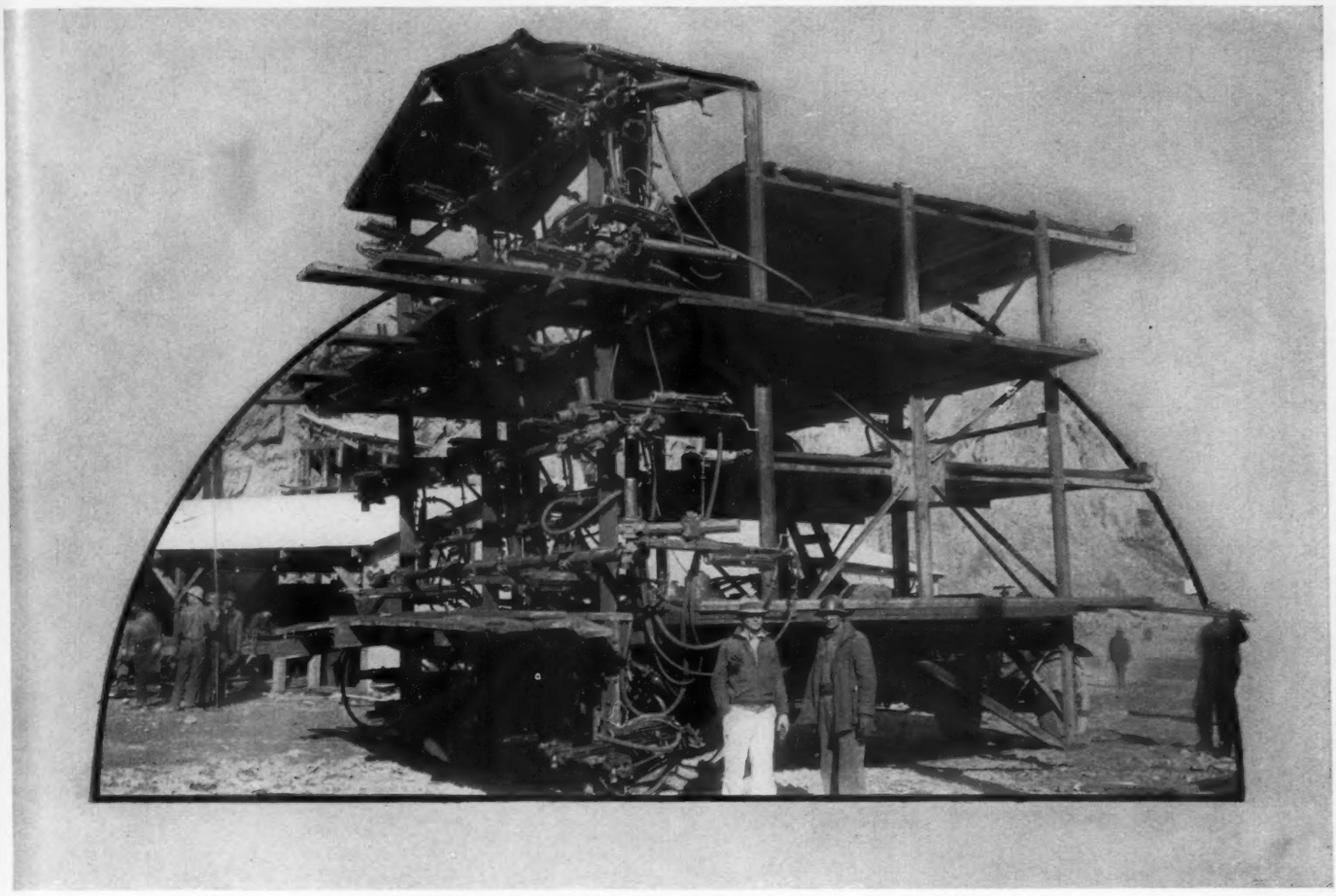
Left—The first office of the United States Marshal. Center—Chief of Police Bodell of Boulder City flanked by two members of his force. Right—The gateway to the reservation where all visitors must secure passes.

STAR LIGHT TO START POWER PLANT

TO THE lay mind it is inconceivable that astronomers can compute to a day the time of arrival on the earth of a ray of light that emanated forty years ago from a star 240,000,000,000,000 miles away. Nor does it seem credible that a light beam from such a remote source could be made to perform a scheduled task. But the fact is that scientists are contemplating this very thing; and, if their plans do not miscarry, it will be the first time in history that a star has been assigned to do man's work.

We are told that on June 1, 1933, there will reach our planet from the great star Arcturus, which is plainly visible on a clear night, the ray under consideration, and on the same date is to be set in operation by means of that light the plant that will provide power for the lamps and machinery in the science buildings of the Chicago International Exposition.

The beam of light, that is said to be speeding earthward at the rate of 186,000 miles per second, is to be received at the telescope in the Yerkes Observatory on Lake Geneva, Wis. There, through the agency of that truly uncanny device—the photoelectric eye, it will cause to be transmitted to Chicago the necessary current which will set in motion the machinery which will signal the opening of the science exhibition. Strange to say, the light that is to do man's bidding at this second large exposition in the Windy City had its birth in 1893 and just about the time the lights were turned on at the first Chicago World's Fair.



One of the drill carriages, with drills in place, shown outside a tunnel portal. The man at the right, in the foreground, is wearing a metal hat of the type adopted for the protection of workmen who are exposed to the hazards of falling rocks.

Mammoth Drill Carriages Speed Hoover Dam Tunnel Work

ALLEN S. PARK

THE accompanying illustrations show the rock-drill carriage which is materially aiding Six Companies Incorporated in driving the huge tunnels that will carry the Colorado River through the solid rock walls of Black Canyon while the Hoover Dam is being built.

This type of carriage, which is believed to be the largest ever constructed, makes it possible to mass 24 to 30 Ingersoll-Rand N-75 drifter drills in a simultaneous attack against the tunnel breast, and is perhaps the most important factor in enabling the contractors to carry on tunneling operations at a much faster rate than was thought possible prior to the beginning of the work.

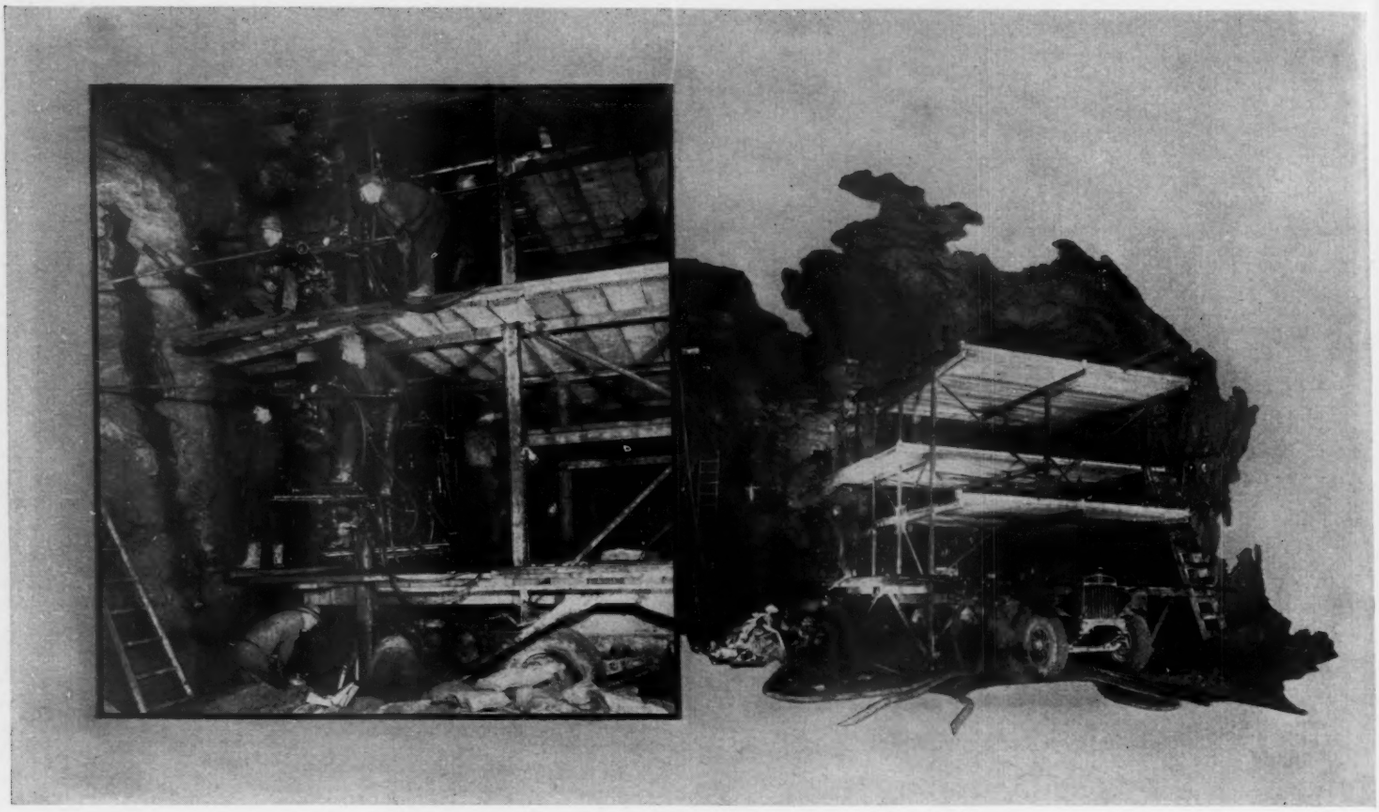
The carriage or jumbo, as it is familiarly known on the job, is the creation of Bernard Williams, general foreman of work in the canyon. He designed and directed construction of the first unit, which proved so effective that similar devices were built and adopted for all the enlargement work.

Each of the four diversion tunnels will be 56 feet in diameter and approximately 4,000 feet long. Considering their length, they are of record size. The Rove Tunnel in France, completed by the French Government in 1927, is 78 feet 6 inches wide and 54 feet 4 inches high, but of short length. No other bore through rock has ever equaled the overall proportions of the Hoover Dam tunnels.

It is obvious that the advancement of such enormous faces presented perplexing problems. The operations required are on such a vast scale as to almost fall in the category of quarrying rather than of tunneling. Six Companies Incorporated considered many possible systems of procedure before beginning actual work. The plan suggested by Mr. Williams was the first one tried; and its success saved much time and money which might otherwise have been expended in experimentation.

The general plan of tunnel advancement was to drive 12x12-foot pioneer headings at the top of the cross section of the 56-foot area ultimately to be taken out. Enlargement was started, however, long before these smaller headings had been completed. In fact, the drill carriage was first tried out at the lower portal of Tunnel No. 4, where the pioneer tunnel had not yet been started. Even there, though, a heading 12 feet high and extending to the arch lines of the completed size was kept one round in advance of the bench. Thus, the procedure was essentially the same as though the pioneer bore had already been driven. As they are now being excavated, the enlargements are carried to their full width but only 40 feet high. This leaves 16 feet in the bottom or invert to be taken out later. With a 12-foot heading excavated at the top, there remains a bench 30 feet high, 56 feet across at its widest line, and 50 feet in average width.

"We wanted some method of driving the tunnels without using ring drilling and without putting in down holes," said Mr. Williams in discussing how they approached the prob-



Two views of a "jumbo" at a tunnel heading. At left, drillers are pointing their machines preparatory to starting a round. The other picture shows a carriage, mounted on its 5-ton truck, backed into position for drilling one side of the 56x30-foot bench.

lem of developing the drill carriages. "Since we had to carry the tunnels at least 40 feet high to allow working headroom for the Marion Type 490 electric shovels to be used in excavating, a 12-foot heading and a 30-foot bench were determined upon as the best plan of attack. A method then had to be devised to drill flat holes in the bench. A drill carriage of some sort seemed to offer the greatest possibilities of filling the requirements. As we intended mucking into trucks, a truck-mounted carriage was the logical solution. It was essential that the drill carriage and the shovel be able to pass in the tunnel, so we decided upon a carriage wide enough to drill half the bench at one set-up."

As can be seen in the pictures, the drill carriage has a steel skeleton which supports wood platforms at four levels. Two of these platforms extend the full length of the carriage and provide working stations for the drilling crews. The other two platforms are of shorter length and serve as drill-steel racks. They are partitioned so that each machine has its set of steel always handy.

The drills are supported on transverse pipe bars secured to the outside of the frame uprights at five levels. Extension arms at the ends of these bars permit of setting up drills for driving holes at suitable angles into the side walls to break the rock approximately to the curve line of the finished excavation desired. Four of the five lines of drills are operated from the two platforms, and the lowest one is operated from the ground.

The carriage is piped for air and water immediately below the drills. A 6-inch air pipe and a 2-inch water pipe are run along the floor of the tunnel at one side up to within 100 feet of the bench. These services are extended to the carriage through the medium of three 2-inch hose lines, two of them for air and one for water. The lines connecting the drills with these sources of supply are 5 feet long. Thus each machine can be moved laterally 4 feet either way from its central position, which is ample to meet all drilling conditions. An apron of sheet steel built above the drills protects the operators from falling rock. The steel uprights of the frame at the four corners of the carriage reach nearly to the ground. This permits blocking the carriage solidly in drilling position with screw jacks. As a result, vibration has never proved bothersome, even with 24 drills running.

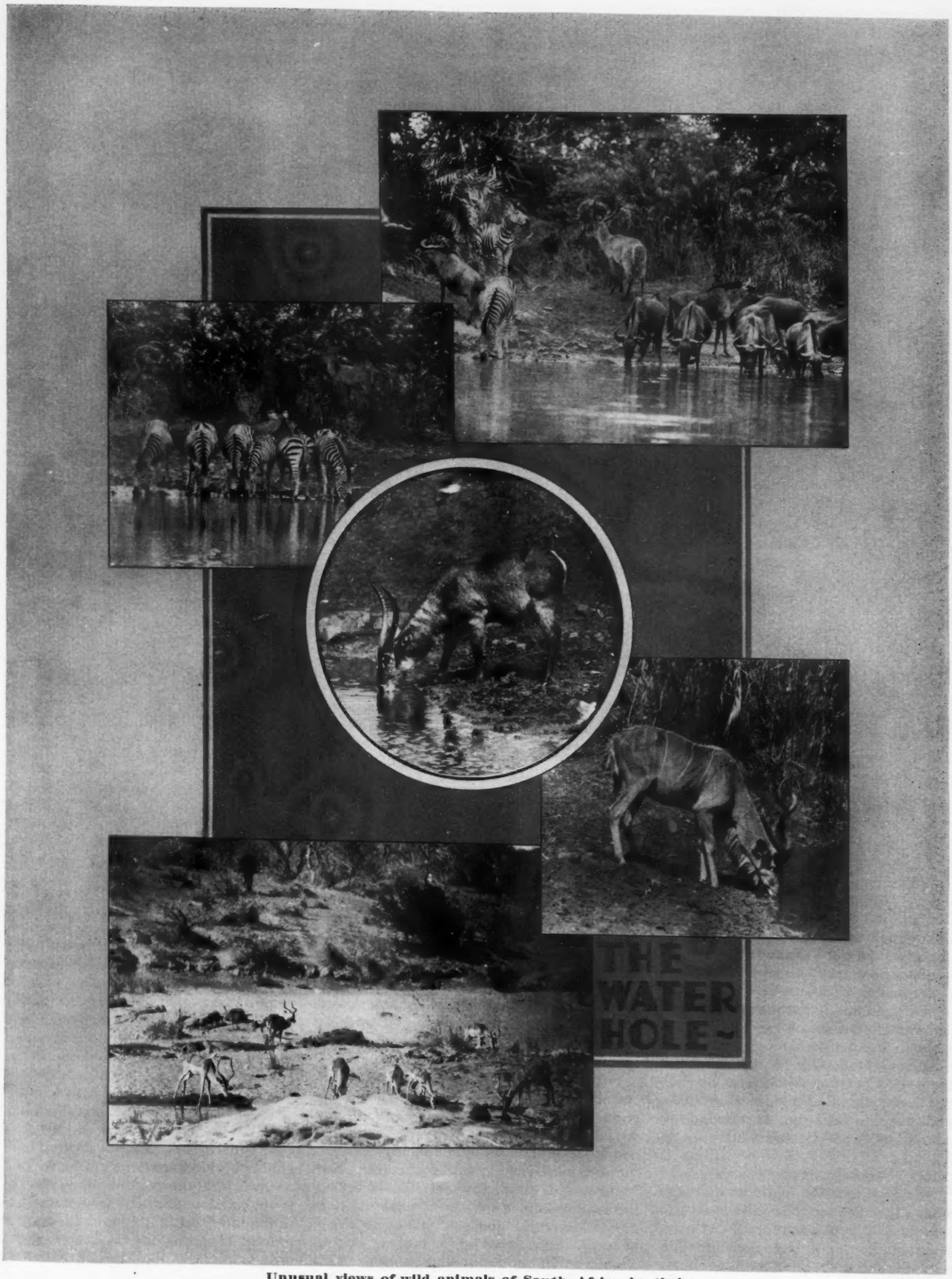
To set up the carriage for work it is necessary only to back the truck into position, connect the water and air lines, block up the corner posts, and point the machines. The average time required for these operations is fifteen minutes, but they have been performed in as few as ten minutes.

After half of the bench has been drilled from one setting of the carriage, the truck is pulled away and backed into position for drilling the other side. When this second half has been drilled, the truck is moved out of the danger zone and the entire round is blasted at one time. After the blast the power shovel is brought up to the face to load the muck into trucks. With the operations thus systematized, there is a minimum loss of time. Records kept for one week at the beginning of the enlargement work in all the tunnels show that the average drilling time was 4.38 hours, the average mucking time 6.95 hours, and slack time only 2.96 hours. Thus the total average time required for a complete round was 14.29 hours. The average advance for each round was 15.11 feet. These figures were considerably improved upon as the crews became better trained; and before the first tunnel was holed through the average advance per round was not only increased but at some faces three rounds were completed in 24 hours.

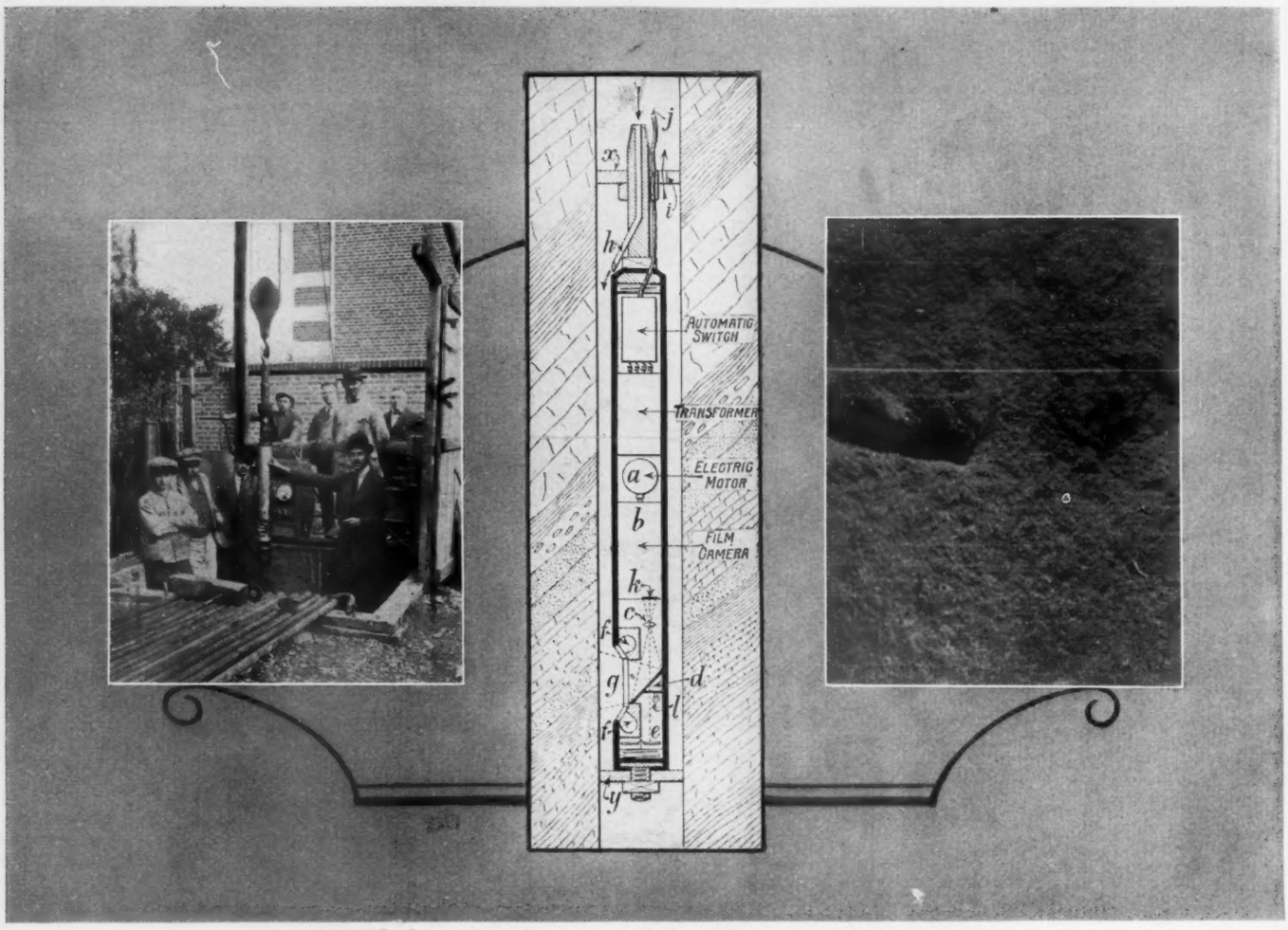
The success of the drill carriage on the enlargement work has prompted the engineers for Six Companies Incorporated to modify it and to use it for drilling the remaining bottom section of the large tunnels. Detailed information on this work is not yet available; but it is the concensus of opinion that the drill jumbo can be utilized to very good advantage.

RUSTLESS SHEET STEEL

SHEET steel with a rust-resisting surface has been introduced by the Superior Steel Corporation of Pittsburgh, Pa. It is ordinary open-hearth steel that has been given a thin veneer, so to speak, of a rustless metal. The product is offered under the name of "Su Veneer"; and it is said to be more enduring than chromium-plated steel and to cost less than solid stainless steel. It is claimed that in the case of 2,000 etched tests of the new material no imperfect weld was detected; and when used in the manufacture of automobile bumpers, the bond held despite the sharp bend necessary to make the rounded ends.



Unusual views of wild animals of South Africa in their native habitats. The top picture shows two zebras, a water buck, and several wildebeeste. Below it, at the left, is a sextet of zebras. A water buck graces the circle, and a koodoo, a member of the antelope family, is shown below it at the right. In the bottom picture the camera has caught a group of antelopes of the impala species.



Left—Camera ready for lowering. Center—Cross section of instrument in position for use: a, electric motor; b, camera; c, lens; d, mirror; e, compass disk; f, f, electric lamps; g, glass window; h, clean-water tube; i, muddy-water outlet; j, electric cable; k, film; l, compass-disk lamp; x and y, packing rings. Right—Enlarged picture taken in a 5½-inch hole showing a water vein in a stratum of tuffaceous chalk 300 feet down.

Camera Takes Pictures in Drill Holes

WOULD it be of value to men engaged in oil-well and exploratory drilling to see just what the walls of the holes they are putting into the ground look like? Obviously, there can be no doubt about it; and the query, discussed in a recent article in *Mining and Metallurgy*, has arisen because there is available a camera that can be lowered into large-diameter bore holes for the taking of pictures. This instrument has been developed by Dr. Thomas Reinhold, of Heemstede, Holland, and has been put to practical use by The Netherlands Geological Survey in locating water.

Doctor Reinhold's apparatus is operated electrically, and electric lights provide the necessary illumination. The light is thrown upon the area to be photographed, and is reflected by a mirror to the lens and thence to the film. After each exposure the film is changed by an electric motor that is actuated by an automatic switch and drawn current from a transformer. Current may be supplied from the surface by means of a cable or it may be furnished by a battery built into the instrument. Through the medium of what is called a compass disk a record is made on each film of its position in relation to the wall so as to facilitate subsequent orientation. This is done by simultaneously photographing the wall and the compass disk, which is lighted by the rays of a small electric lamp.

Fitted at the top and the bottom of the camera are adjustable packing rings that serve the dual purpose of segregating the section containing the apparatus from the rest of the drill hole and of cleaning the walls by raising and lowering the instrument. But before this is done clear water is allowed to flow down into the confined area to force muddy water out. When oil is present, either benzine or gasoline may be used to do the washing. By changing the packing rings, the camera can be used in holes varying in diameter from 5½ to 12 inches.

In service, the instrument is attached to the drill rods or drill pipe; the contiguous wall surfaces are cleaned; and the exposures are made after the lights have been switched on. As the apparatus can be turned about its axis as well as raised and lowered, it is possible to take a succession of all-round pictures that, when properly assembled after developing, will reveal the condition and the character of the ground penetrated. The camera can be loaded with film sufficient to make several hundred exposures.

In its present form, the instrument is not adapted for deep-hole work such as it would be called upon to do especially in oil fields. But, suitably modified, an apparatus of this kind would unquestionably prove of value to the industry both in providing photographs of the interiors of drill holes for study and in periodically inspecting casings of wells to prevent failure at any point through various causes.

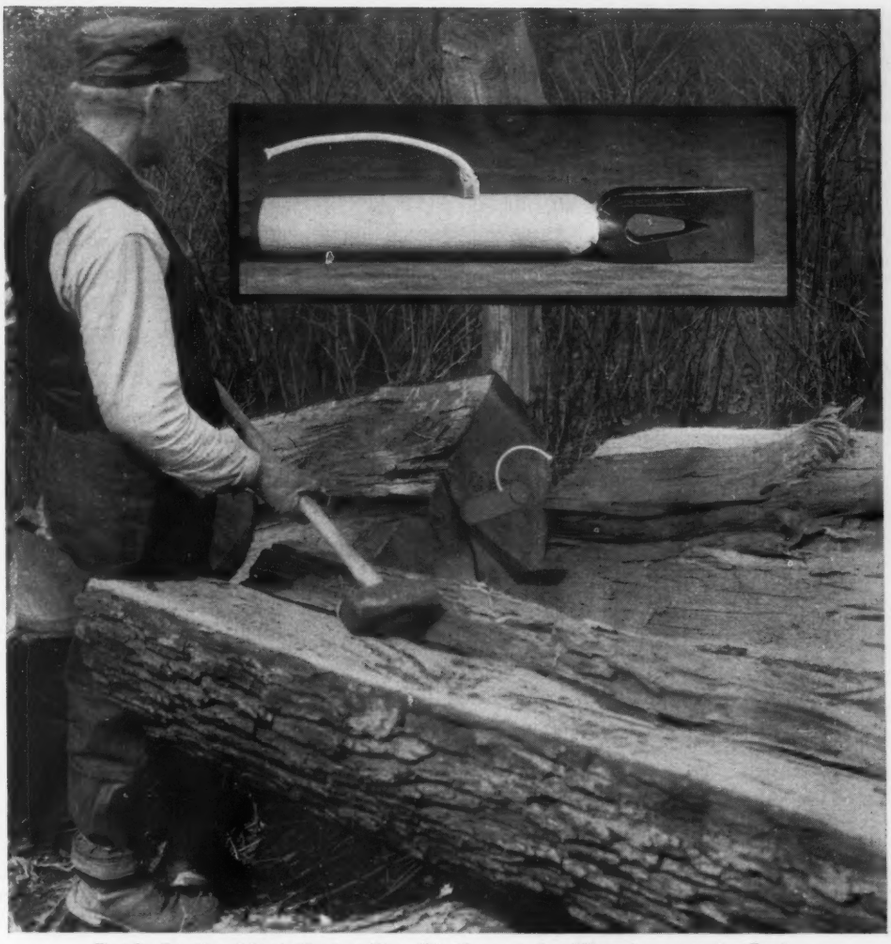
At the recent annual meeting of the American Institute of Mining and Metallurgical Engineers, the subject of Doctor Reinhold's camera as an adjunct to oil-drilling equip-

ment was brought up; and according to Messrs. Bela Low and Sherwin F. Kelly, who exhibited one of the instruments, "Pictures of uncased portions of bore holes would permit recognition of the general fissured or caved nature of the rocks and identification of such formations as shale, coal, sandstone, limestone, etc. Photographs of the wall with the compass disk showing would make it possible to calculate the dip and strike of inclined beds and to determine the position, direction, and inclination of contacts between different formations.

"Failure of casings due to corrosion, cutting by wire lines, wear by tubing, or shifting of formations could be detected and frequently forestalled by photographic inspection at regular intervals. Where water flooding has resulted from imperfectly seated casings or from corrosion punctures, it may be possible to locate the point of trouble photographically and repair it with the least waste of time and money. Bulging and unscrewed tubes may be found; and before pulling pipes they may be photographed to determine whether they should be pulled or left in place. The condition of damaged or clogged strainers also may be ascertained. A photographic inspection before plugging back crooked holes would be useful, and the actual results of reaming and under-reaming might be made visible. Before cementing, a picture would show whether the casing shoe was well landed, and, in general, discover the condition of the hole. A slight alteration would make it possible to photograph downward, which would be helpful in locating lost tools.

"Another likely field might be in connection with churn drilling in ore exploration. Although the sludge shows when ore has been penetrated, the exact depth of the horizon is uncertain. It may be assumed, though this would require some experimenting, that usually a photograph would permit distinguishing ore from rock. Although the work done shows that photographs can be taken in holes even when filled with mud, the camera is suited mainly for use in hard rocks such as the Carboniferous or older formations. In the softer Tertiary sands and clays the mud will penetrate the formations and cannot be washed off so well."

Building a $150,000 suspension bridge for the express purpose of carrying a pipe line across a river is rather an uncommon procedure, but that is what is being done by the Northern Gas & Pipe Line Company. The span is in course of construction at Ponca, Nebr., on the Missouri, and is to have a length of 1,280 feet. It will consist of three cables—two supplementary cables to stiffen the pipe against wind stresses, and a main cable from which the pipe line will be suspended in cradles spaced on 20-foot centers. The latter with its fourteen strands, each of which will be taken over separately, will have a total weight of 28 tons. The towers to which the cables are to be anchored are being cemented to a depth of 20 feet in solid rock and will rise to a height of 160 feet above the water level. The pipe line, which is designed for the transportation of gas, will have a clearance at mean high water of 66 feet.



Ready for the blast that will split the wood without manual effort. Insert—The exploding wedge that makes wood splitting light work. The hole is filled with powder packed tight with a 1-inch paper wad.

Wood-Splitting Made Easy

INSTEAD of the lusty ring of the ax, the muffled bang of an explosive charge may in future be heard when the farm hand or the farmer, himself, is busy laying in the winter's supply of cordwood. Splitting logs in the time-honored way is back-breaking work if it is done in earnest and for other than the exercise; and those that have to fill the woodshed, whether they want to or not, should be interested in a so-called exploding wedge that has been devised by the Hutchison Manufacturing Company to do the hard work for them.

The wedge needs no description, as the accompanying pictures plainly show its construction and method of application. Its use calls for the ordinary precautions taken when handling explosives. When charged with a suitable blasting powder, and driven well down into a log, the touch of a match to the fuse is all that is needed, so it is claimed, to split the wood clean even if it is so tough that it is next to impossible to split by hand wedging. In the case of short logs, the wedge is driven into the end and slightly above center; but when it is to be employed for the splitting of logs up to 20 feet long, then it should be hammered into the top about midway of its length, always being careful to use a wooden maul or a sledge with a wooden face.

Many trees such as gumwood, cottonwood, elm, and water poplar, that have been toughened by the weather, have been left standing on land that it might pay to cultivate because the farmer has found that the timber is not worth the labor and the cost of cutting and splitting by hand. Instead of allowing these trees to rot on the ground, he can now split them up with little effort into firewood, fence posts, or even a commercial product like mine props and thus make them yield a return besides enabling him to put the cleared acreage to use.

The wedge is made of high-grade, heat-treated carbon steel so as to give it long service life. This, of course, depends upon the treatment it receives; but individual ones are said to have survived the shock of as many as 1,000 explosions. To protect the wedge during driving, it is covered with a malleable gray-iron cap provided with an eye and an open link for attaching a log chain to prevent the loss of the wedge in the brush.

AIR-DUMP CAR OF LARGE CAPACITY

AN AIR-operated dump car of far larger size than was heretofore considered practicable has been built by the Western Wheeled Scraper Company. It has a capacity of 20 cubic yards—level full; is of heavy construction throughout so as to stand up under severe power-shovel loading; and is designed for end dumping. The body is mounted on standard-gage trucks capable of sustaining a load of 100,000 pounds, and is tilted 45° from the horizontal by the direct thrust of large air cylinders. Release of the air from these cylinders returns the body to its normal position. Compressed air for this service is furnished by the locomotive hauling the car, and is piped to a storage tank on the car. This tank contains sufficient air to hoist the body for dumping.

As the bed or body is tilted, the door or end gate automatically turns downward until it is parallel with the floor of the car, thus forming an apron or chute that dumps the material clear of the end of the rails on which the car travels. A car of this type at the rear of a train of side-dump cars is said to be especially suitable for building stock piles of rock or ore, for constructing breakwaters, and for filling in or extending earth fills, which latter work it can do without the need of trestle work or cribbing.

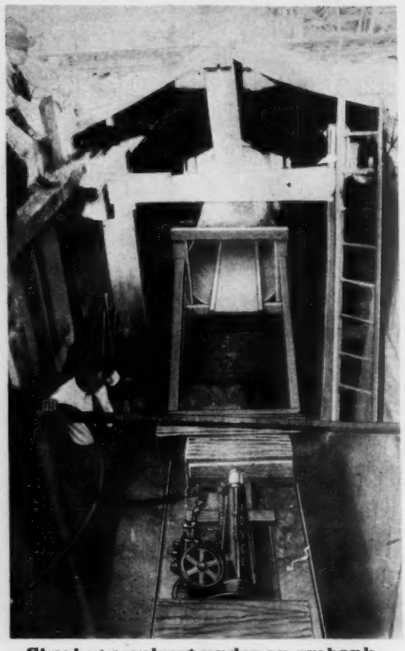
Air-operated, 20-cubic-yard end-dump car on a filling-in job.

PNEUMATIC JACKS PUSH CULVERTS AND PIPES INTO PLACE

SOME well-known contractors of the Middle West, including the Collier Construction Company and the J. A. Mercier Company, have been using, apparently with complete success, a system of installing pipes and culverts as developed by The Joyce-Cridland Company of Dayton, Ohio. This concern has put out a special jack hoist by means of which pipes and culverts can be pushed through the ground without manual effort.

Hoists with capacities up to 100 tons are built. They are of the single-unit type consisting of a jack, a series of gears, and a 3¼-hp. heavy-duty Ingersoll-Rand reversible air motor drawing power from a portable compressor. Automatic shut-offs at both the upper and the lower limits of the ram assure safety in operation. One man can control one or any number of the hoists from a "Y" valve, or, if but one machine is in service, direct from the air motor if desired.

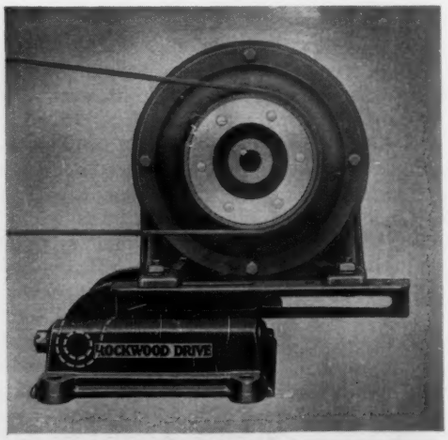
Under maximum load, reports the manufacturer, units of 50 and 100 tons capacity are extended their full length in three minutes. In the case of lighter loads this may be effected in as little time as one minute. By using three Joyce jack hoists instead of the procedure he had followed previously on work of this kind, one contractor claims to have saved as high as $600 a day on a 26-mile pipe-pushing job completed by him in Detroit. Where culverts are concerned, the jacking method of installation has resulted in savings of as much as $2 per foot.



Shoving a culvert under an embankment by means of the air-operated jack hoist.

ADJUSTABLE DRIVE BASE FOR MOTORS

A NEW short-center drive base adaptable to all types of motors is announced by the Rockwood Manufacturing Company of Indianapolis, Ind. The base has adjustable arms which permit moving the motor nearer to or farther from the pivot shaft, as desired, so as to utilize exactly the proportion of the motor's weight that the installation requires.



The adjustable drive base with the motor set at the farthest point from the pivot shaft.

It is thus possible to maintain the correct belt tension, with consequent reduced belt wear and lessened chance of overheating or burning out the motor. If the load requirement changes, the drive can be adjusted accordingly. The base is made in a range of sizes suitable for all motors from 1 hp. to 100 hp.

NEW PACKING FOR HEAVY-DUTY HYDRAULIC EQUIPMENT

A PACKING that becomes tighter with increasing pressure has been patented and put on the market by the Garlock Packing Company. It is known as Chevron packing because it is built up of chevron-shaped rings that permit the use in shallow stuffing boxes, for example, of a gasket composed of a number of rings. This, together with the unusual construction, makes for a more effective packing than would otherwise be the case.

Garlock Chevron packing is furnished only in ring sets for rams and plungers of accumulators, presses, pumps, and other heavy-duty hydraulic equipment, and each set is provided with top and bottom adapter rings that conform to the bevel of the gland and of the stuffing box. For ordinary service Garlock-430 Chevron is specified, but for high-temperature use a packing of the same design but of a special heat-resisting material is available.

Garlock Chevron packing and one of the two adapter rings that complete a set.

RUBBER POWDER BAGS FOR MINE USE

"SAFETY First" is the thought behind the rubberized-fabric bags for explosives that have recently made their appearance on the market. They have been designed by Frank A. Halverson, of Glen Richey, Pa., for the transportation of powder and dynamite in mines so as to eliminate all possible risk of explosion in transit.

There are two models of these sparkproof and waterproof containers, and they are provided with straps so they can be suspended from the shoulder, leaving the miner's hands free. One is of a size to take a standard powder can or jack. The second consists of two separate bags which are large enough to hold a day's supply of caps and pellet powder or dynamite. The latter container is so arranged that each stick of dynamite can be stowed in its own compartment to prevent dangerous friction.